DEPARTMENT OF

CHEMISTRY

CHEM UG Courses

UG Courses offered in Spring Term 2025-2026 but the courses outlines are not time-specific

Course Code	Course Title
CHEM 1004	Chemistry in Everyday Life
CHEM 1008	Introductory Chemistry
CHEM 1011	General Chemistry A: Reactions, Thermodynamics, and Reaction Kinetics
CHEM 1012	General Chemistry B: Atomic Structure, Molecules, and Bonding Theories
CHEM 1051	Laboratory for General Chemistry A
CHEM 1052	Laboratory for General Chemistry B
CHEM 2155	Fundamental Organic Chemistry Laboratory
CHEM 2311	Analytical Chemistry
CHEM 2355	Fundamental Analytical Chemistry Laboratory
CHEM 3120	Organic Chemistry II
CHEM 3220	Inorganic Chemistry II
CHEM 3320	Instrumental Analysis
CHEM 3420	Physical Chemistry II
CHEM 3550	Synthetic Chemistry Laboratory II
CHEM 3555	Molecular Characterization Chemistry Laboratory II
CHEM 3030	Introduction to AI for Chemistry
CHEM 4130	Medicinal Chemistry
CHEM 4240	Intermediate Inorganic Chemistry

Course Code	Course Title
CHEM 4330	Separation Science
CHEM 4410	Physical Chemistry in Biological Applications
CHEM 4420	Statistical Machine Learning Methods for Chemical Data Analysis
CHEM 4620	Organometallic Chemistry
CHEM 4680	Undergraduate Research
CHEM 4689	Capstone Project
CHEM 4691	Capstone Research I
CHEM 4692	Capstone Research II

The Hong Kong University of Science and Technology

UG Course Syllabus

Chemistry in Everyday Life
CHEM 1004
3 Credits
Previous Course Code(s): CORE 1120
Exclusion(s): Level 3 or above in HKDSE Chemistry, a passing grade in GCE-A/As Level Chemistry, CHEM 1008, CHEM 1010, CHEM 1011, CHEM 1012, any CHEM courses at or above 2000-level
Cross-Campus Equivalent Course: UCUG 1900

Lectures:	LG3008 (Lift 10-12) Tuesday and Thursday 9:00 – 10:20 No lectures on Feb 17, Feb 19, Apr 7
Course Instructor:	**Prof. Emily M.W. TSANG** Assistant Professor of Science Education Department of Chemistry, HKUST Email: **chetsang@ust.hk** Office: Rm 4536 (4/F, Lift 25/26)
Course website:	**https://canvas.ust.hk**

Course Description

This common core course takes students on a chemical journey, through which they will learn what is chemistry and how chemistry connects with our daily life and sustainable development. Students will engage in a self-guided study project; they will also learn chemical concepts through many real-life case studies. The basic ideas and principles of chemistry, as well as important chemical topics related to human activities and our environment will be discussed in this course: such as air, water, metals, minerals, air pollution, global warming, ozone depletion, batteries, fire and fuels, food and drinks, household chemical products and plastics. Students taking this course are not required to have studied Chemistry before.

Course objectives are as follows:
1. Introduce basic concepts of Chemistry.
2. Connect Chemistry with everyday life and modern technology.
3. Explain the importance of Chemistry in the environment, medicine, and daily life.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain basic fundamental concepts of Chemistry, recognize basic chemical terminology and be able to perform simple chemical calculations.

2. Demonstrate an understanding of how Chemistry connects with our everyday experience, modern technology, and environmental sustainability issues.

3. Explain the basic Chemistry behind major environmental issues, common household items, and important industrial processes.

4. Obtain scientific information on chemistry topics of everyday and environmental relevance and to think critically from a chemistry perspective.

Course Outline

The course is divided into six Chapters:

Chapter 1:	What is everything made of?
Chapter 2:	The Air.
Chapter 3:	The air and our environment.
Chapter 4:	The metals in our daily life.
Chapter 5:	Metals in the industry.
Chapter 6:	Fire and fuels.

Lectures

The lectures are critical to your understanding of course materials. You should try to attend all the lectures. We will show some interesting experiments during some of the classes and they are best viewed in person. Lecture recordings will be provided on Canvas after **each class**, so please catch up promptly when you missed a class.

Course Contents

Comprehensive **lecture notes** will be provided for this course. These notes should be very helpful to you as they provide more details of the lecture materials than power point slides. However, the version of the notes you receive is incomplete. You will need to fill in some important details or draw diagrams to complete the notes during the lectures.

You should print out hard copies of the lecture notes and bring them to the class. You can staple each chapter's notes into a booklet.
It would be advisable to print them single sided, so that you can use the blank page to jot down extra notes that the lecturer mentions but are not in the notes, or to write some references you obtained from other sources or your revision notes.

The **power point slides** will be mostly pictures or graphics. The slides will be released on Canvas.

The lecture notes will be released by chapter. New chapters will be released on Canvas towards the end of the current chapter. You can read through the notes before the lecture to familiarise yourself with the materials.

Textbooks/Reading List

You don't need a textbook for this course, and since we draw examples from many different areas of chemistry in everyday life, no one textbook is a perfect fit for the course. Therefore, for each chapter, some reading materials will be suggested to you for optional reference.

End of Chapter Exercises and Tutorial Sessions

To help you prepare for the examination, each chapter will finish with a short **exercise**. These exercises will require you to work through a set of problems, using some knowledge from the lectures and also to teach you some new knowledge through the exercise.

These exercises will **not** be formally graded, but they will be examinable.

Office Hours of the Instructor

Please feel free to approach the instructor, Prof. Emily Tsang to ask questions or to discuss any chemistry or course-related issues. You may approach her after the lectures, or you may email her to arrange an appointment. There is no fixed office hour schedule: if you need one, feel free to email and book a time.

Online Graded Quizzes (15 % of the course)

There will be two online graded quizzes in addition to the end-of-chapter exercises, the first quiz is **after Chapter 4** (covering Chapters 1 – 4), and the second quiz is at the end of the course (covering mainly Chapters 5 – 6). You should complete them within the given time (typically 2 – 3 days). The accumulated points from the online quizzes will carry 15 % to the course grade, but the main purpose is to help you further understand the course materials and have a chance to practice and receive answers immediately after submission. When these quizzes are available, you will receive email notification as well as instructions during the lectures.

Study-Project (30 % of the course)

This course will have a study project component for you to learn more about a particular area of everyday chemistry that interests you. The project period will commence about 3 weeks into the course. In view of the time needed for this project, **there will be no mid-term examination** for this course.

Every student will undertake a study project. You will choose a topic yourself that is about any chemistry phenomenon or chemicals that is in your everyday life. Be creative and explore interesting topics!

You are expected to read widely, using resources available to you, not limited to the internet – you also have access to books, journal articles and other multimedia resources. Photographs would be needed to demonstrate that your topic is truly something you can connect to in the real world.

The article should bring together many ideas to draw up an original story. Originality checks will be performed so you must do the writing yourself.

More information will be announced during a lecture around Week 3.

Final Examination (55 %)

On-campus proctored examination during the final exam period: This course will end with a *closed-book* final examination (2 hours). This will cover all the lecture materials and exercises that were taught in the course. You will mainly be tested on your understanding and ability to solve problems rather than solely on the memorisation of facts, but you should also be familiar with some key chemical details – some of these will inevitably require some memorisation.

Grades

The final grade for the course will be consisted of:
15% from the Online Quizzes
30% from the Study Project
55% from the Final Examination
The course is graded from A+ to F. An F grade will not earn you credits for the course.

Assessment and Grading

Weight	Assessment	Course ILOs	CHEM Program ILOs
15%	Online Revision Quiz	1, 2, 3, 4	1, 2, 3
30%	Study Project	1, 2, 3, 4	3, 6, 11, 12, 13
55%	Final Exam	1, 2, 3, 4	1, 2, 3

Teaching and Learning Activities (Non-assessed)

Activities	Course ILOs	CHEM Program ILOs
Lecture	1, 2, 3, 4	1, 2, 3
End of chapter exercises and Tutorials	1, 2, 3, 4	1, 2, 3

Topics by Chapter

Chapter 1: What is everything made of?	**~2 Lectures**	Introduction of the course Discovery of the atomic structure Elements; relative atomic mass relative molecular mass The mole Chemical calculations Relationship between mole and mass, mole and concentration, mole and gas volume Calculations, Common elements
Chapter 2: The Air	**~3 Lectures**	Gases in the Air, Electronic configuration Forming covalent bonds

		States of matter, separation of gases in air, Intermolecular forces: London dispersion force Electronegativity, Polar and non-polar molecules, Intermolecular forces: dipole-dipole interactions
Chapter 3: The air and our environment	**~5 Lectures**	Electromagnetic waves Greenhouse gases, Greenhouse effect, Global Warming, Carbon cycle, Reducing CO_2 emission Acids and Bases Air Pollution: Acid Rain and other air pollutants Reading organic chemical structures Air Pollution: VOCs, smog, PMs Controlling air pollution Ozone and ozone depletion
Chapter 4: The metals in our daily life	**~5 Lectures**	Different groups of metals in the periodic table: Alkali metals, Alkaline earth metals, Transition metals, Lanthanides, metals in Group 13-15, Radioactivity and the Actinide elements Structure of Metals, Metallic bonding Metal lattice systems Physical properties of typical metals; Alloys Alloys: types and applications Compounds of metals: Ionic bonding Name and Formula of ionic compounds Structure of complex ions Solid structure of ionic compounds Ionic lattice systems Physical properties of ionic compounds Reaction of metals with oxygen Reaction of metals with water Reaction of metals with acids
Chapter 5: Metals in the industry	**~6 Lectures**	Metal extraction industry Calculate %mass of metal in a compound Redox

		Oxidation number Metal displacement reactions Metal displacement reactions Extraction of Metals by heating with carbon: Copper, Iron (Blast Furnace, Basic Oxygen Converter) Electrolysis of molten ionic compounds: Extraction of sodium Electrolysis of molten ionic compounds: Extraction of aluminium Electrolysis of aqueous solution The chloroalkali industry The refining of copper metal Electroplating Anodising aluminium Half cells and standard electrode potentials Electrochemical cells Fruit batteries, zinc-carbon batteries Alkaline batteries Silver oxide cells Rechargeable batteries: Ni-MH batteries Lithium metal batteries Lithium-ion batteries
Chapter 6: Fire and fuels	**~3 Lectures**	Fire and combustion, Fire triangle How to fight a fire Fire extinguishers Introduction to fossil fuels: coal, natural gas and crude oil Alkanes: naming and isomers Fractional distillation of crude oil Fractions from crude oil Cracking Alkenes Polymers

		Calculating energy from combustion reactions Starting a fire Fireworks Explosives

The Hong Kong University of Science and Technology
UG Couse Syllabus

Introductory Chemistry
CHEM 1008
3 Credits
Exclusion(s): Level 3 or above in HKDSE 1/2x Chemistry OR HKDSE 1x Chemistry, any CHEM courses at or above 1004-level, CORE 1120

Instructor(s)
Prof. Kenward VONG
Email*: kvong@ust.hk
Office: Rm 4521 (Lifts 25/26)
Prof. Emily M. W. TSANG
Email*: chetsang@ust.hk
Office: Rm 4536 (Lifts 25/26)
Instructor office hour by email appointment

Class Schedule and Venue
Tu Th 12:00 pm – 1:20 pm LT-B

Course Description

This course targets science or engineering students with very little to no chemistry background. It provides a general introduction to basic principles of chemistry. Key topics include state of matters, atoms and elements, molecules and compounds, atomic structures and periodicity, molecular structures, quantities in chemical reactions, bonding theories, acids and bases, and solution chemistry. Students without HKDSE qualifications may seek instructor's approval for enrolment.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Develop a microscopic view of the world in terms of atoms and molecules.
2. Recognize physical/chemical properties, physical/chemical changes.
3. Apply knowledge of states of matter, chemical reactions, stoichiometry, atomic structure, chemical bonding, molecular structure, and intermolecular interactions.
4. Obtain a basic knowledge of solution chemistry, acid-base chemistry, chemical equilibrium.
5. Recognize and appreciate the impact and significance of chemistry to our society.

Course Content/Topics:

Chapter 1: Matter and Energy	Chapter 7: Electrons in Atom and the Periodic Table
Chapter 2: Atoms and Elements	Chapter 8: Chemical Bonding
Chapter 3: Molecules and Compounds	Chapter 9: Solids, Liquids, and Intermolecular Forces
Chapter 4: Chemical Composition	Chapter 10: Properties of Solutions
Chapter 5: Chemical Reactions	Chapter 11: Acids and Bases
Chapter 6: Reaction Stoichiometry	Chapter 12: Chemical Equilibrium

Grading and Assessment

Online Quizzes (2 x 10% each)	20%
In-class Midterm Exam	40%
In-class Final Exam	40%

The Hong Kong University of Science and Techonology

UG Course Syllabus

General Chemistry A: Reactions, Thermodynamics, and Reaction Kinetics
CHEM 1011
3 Credits
Previous Course Code(s): CHEM 1030
Pre-requisites: Level 3 or above in HKDSE 1/2x OR level 3 or above in HKDSE 1x Chemistry OR CHEM 1004 OR CHEM 1008

Instructor:
Name: Dr. Frederick Fu Kit SHEONG (1st half of the course)
Email: chemfksheong@ust.hk

Name: Prof. Zhenyang LIN (2nd half of the course)
Email: chzlin@ust.hk

Instructional Assistant:
Name: Dr. Long Yiu TSANG
Email: lytsangchem@ust.hk

Office Hours: Every Wednesday, 1:30pm – 4:00pm, at Room 4507

Course Description

This course targets at students who have acquired prior knowledge in fundamental Chemistry in high school. Key topics include stoichiometry, chemical energy, properties of aqueous solutions, acids and bases, thermodynamics and equilibrium, reaction kinetics, and electrochemistry.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Analyze properties of solutions and determine stoichiometry of chemical transformations.
2. Describe different definitions of acids and bases theories and understand acid-base equilibrium.
3. Apply the laws of thermodynamics and account for the factors that lead to spontaneous physical and chemical changes.
4. Describe redox reactions, use electrochemical data to predict the spontaneity of redox reactions, and comprehend the structures of electrochemical cells.
5. Understand the fundamental chemical properties of organic and biological molecules at a molecular level, differentiate between synthetic and natural polymers while appreciating the diverse roles played by biological molecules such as starch, cellulose, proteins, DNA, and RNA in living systems.
6. Recognize the impact of chemistry to society.

Course Topics

Chapter 10:	Properties of Solutions
Chapter 12:	Chemical Equilibrium
Chapter 13:	Acids and Bases
Chapter 14:	Acid-Base Equilibria
Chapter 15:	Solubility and Complex Ion Equilibria
Midterm Exam (Chapters 10, 12-15)	
Chapter 16:	Spontaneity, Entropy, and Free Energy
Chapter 17:	Electrochemistry
Chapter 11:	Chemical Kinetics
Chapter 18:	The Nucleus: A Chemist's View
Chapter 21:	Organic and Biological Molecules
Final Exam (Chapters 11, 16-18, 21)	

Assessment and Grading

Assessment	Contribution	Due date
Assignment 1	5%	Week7
Mid-term exam	45%	Week8 March 28 (Sat)
Assignment 2	5%	Week14
Final exam	45%	Week15

Mapping of Course ILOs to Assessment Tasks

Assessment	Course ILOs	Explanation
Assignment 1	1, 2	The assignment is designed to assess students' foundational understanding of the properties of solutions (ILO 1) and the definitions of acid-base theories (ILO 2).
Midterm exam	1, 2, 6	This midterm assesses students' ability to analyze the properties of solutions, determine the stoichiometry of chemical transformations (ILO 1), determine acid-base equilibria (ILO 2), and recognize the impact of chemistry on society (ILO 6).
Assignment 2	3, 4, 5	The assignment is designed to assess students' foundational understanding of thermodynamics in chemical reactions (ILO 3),

		electrochemistry (ILO 4), and the chemical properties of organic and biological molecules (ILO 5).
Final exam	3, 4, 5, 6	This final exam assesses students' ability to apply the laws of thermodynamics to determine spontaneous physical and chemical changes (ILO 3), describe redox reactions and comprehend the structures of electrochemical cells (ILO 4), determine the chemical properties of organic and biological molecules and polymers (ILO 5), and recognize the impact of chemistry on society (ILO 6).
Participation	1, 2, 3, 4, 5, 6	Students can achieve all ILOs via participation.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within one week of submission. Paper checking sessions are provided for midterm and final exams.

Required Texts and Materials

Textbook: Chemistry – an atoms first approach (3e)
Authors: Steven S. Zumdahl, Susan A. Zumdahl and Donald J. Decoste

Academic Integrity

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The Hong Kong University of Science and Techonology

UG Course Syllabus

General Chemistry B: Atomic Structure, Molecules, and Bonding Theories
CHEM 1012
3 Credits
Previous Course Code(s): CHEM 1020
Pre-requisites: Level 3 or above in HKDSE 1/2x OR level 3 or above in HKDSE 1x Chemistry OR CHEM 1004 OR CHEM 1008
Exclusion(s): CHEM 1010

L1 & L2 Instructors:
Name: Prof. Haipeng LU (1st half of the course)
Email: haipenglu@ust.hk

Name: Prof. He YAN (2nd half of the course)
Email: hyan@ust.hk

L3 & L4 Instructors:
Name: Prof. Zhihong GUO (1st half of the course)
Email: chguo@ust.hk

Name: Prof. Tengteng CHEN (2nd half of the course)
Email: tengtengchen@ust.hk

Instructional Assistant:
Name: Dr. Long Yiu TSANG
Email: lytsangchem@ust.hk

Office Hours: Every Wednesday, 1:30pm – 4:00pm, at Room 4507

Course Description

This course targets at students who have acquired prior knowledge in fundamental chemistry in high school. Key topics include atomic structure and periodicity, molecules, bonding theories, and properties of gases, liquids and solids. Other topics such as transition metals and coordination compounds, and organic molecules will be briefly reviewed.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Describe and apply elementary concepts and terminologies of chemistry
2. Describe the structure of atoms and periodicity, and determine electron configurations.
3. Describe and apply the concepts of bonding theory.
4. Describe properties of gases, liquids and solids.
5. Describe properties of transition metals, and coordination compounds.

Course Topics

Chapter 1:	Chemical Foundations
Chapter 2:	Atomic Structure and Periodicity
Chapter 3:	Bonding: General Concepts
Chapter 4A:	Molecular Structure and Orbitals: Valence Bond Theory
Midterm Exam (Chapters 1-4A)	
Chapter 4B:	Molecular Structure and Orbitals: Molecular Orbital Theory
Chapter 8:	Gases
Chapter 9:	Liquids and Solids
Chapter 20:	Transition Metals and Coordination Chemistry
Final Exam (Chapters 4B, 8-9, 20)	

Assessment and Grading

Assessment	Contribution	Due date
Online Quiz 1	10%	Week6
Mid-term exam	40%	Week10 April 12 (Sun)
Online Quiz 2	10%	Week12
Final exam	40%	Week15

Mapping of Course ILOs to Assessment Tasks

Assessment	Course ILOs	Explanation
Online Quiz 1	1, 2	Assignment 1 is designed to assess students' foundational understanding of the concepts and terminologies of chemistry (ILO 1), as well as concepts related to atomic structure, periodicity, and electron configurations (ILO 2).
Midterm exam	1, 2, 3	This midterm assesses students' ability to apply elementary concepts and terminologies of chemistry (ILO 1),

		determine electron configurations and atomic orbitals (ILO 2), and apply the concepts of bonding theory (ILO 3).
Online Quiz 2	3, 4	Assignment 2 is designed to assess students' foundational understanding of molecular orbital theory (ILO 3) and the concepts related to the properties of gases, liquids, and solids (ILO 4).
Final exam	3, 4, 5	This final exam assesses students' ability to apply the concepts of molecular orbital theory (ILO 3), describe the properties of gases, liquids, and solids (ILO 4), and describe the properties of transition metals and coordination compounds (ILO 6).

Communication and Feedback
Online quiz marks for individual assessed tasks will be communicated via Canvas within one week of submission. Paper checking sessions are provided for midterm and final exams.

Required Texts and Materials

Textbook: Chemistry – an atoms first approach (3e)
Authors: Steven S. Zumdahl, Susan A. Zumdahl and Donald J. Decoste

Academic Integrity

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The Hong Kong University of Science and Technology

UG Course Syllabus

Laboratory for General Chemistry A

CHEM 1051

1 Credit

Co-requisite: CHEM 1011

Name: CHEUNG Man Sing

Email: sing@ust.hk

Office Hours: By email appointments

Course Description

This course is the laboratory class designed for students who are enrolled in CHEM 1011. With laboratory experience acquired in this course, students will be able to relate the physical and chemical principles and theories learned in the corresponding lecture course, perform basic chemical laboratory techniques, and develop their data analyzing skills.

Intended Learning Outcomes (ILOs)

On successful completion of the course, students will be able to:

1. recognize various kinds of equipment in chemistry laboratory
2. conduct standard laboratory procedures involved in basic chemistry experiments
3. conduct risk assessments concerning the use of chemical substances in basic chemistry experiments
4. keep records of experimental work in basic chemistry experiments
5. interpret experimental results for physical and chemical phenomena in basic chemistry experiments

Assessment and Grading

This course will be assessed based on the fulfillment of specific requirements to pass, and grades will not be assigned using a curve. Detailed requirements for each assessment task are provided below.

Assessments:

Assessment Task	Contribution to Overall Course Grade (%)	Due Date*		
		LA1 & LA2	LA3 & LA4	LA5 & LA6
Pre-course Tests	-	17/02/2026	18/02/2026	19/02/2026
Experiment 1	-	03/03/2026	04/03/2026	05/03/2026
Lab Report 1	-	10/03/2026	11/03/2026	12/03/2026
Experiment 2	-	17/03/2026	18/03/2026	19/03/2026
Lab Report 2	-	24/03/2026	25/03/2026	26/03/2026
Experiment 3	-	31/03/2026	01/04/2026	02/04/2026
Lab Report 3	-	07/04/2026	08/04/2026	09/04/2026
Experiment 4	-	14/04/2026	15/04/2026	16/04/2026
Lab Report 4	-	21/04/2026	22/04/2026	23/04/2026
Experiment 5	-	28/04/2026	29/04/2026	30/04/2026
Lab Report 5	-	05/05/2026	06/05/2026	07/05/2026

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Pre-course Tests (Safety Test and Laboratory Apparatus Test)	ILO1, ILO2, ILO3	Safety Test is designed based on Safety Orientation provided by HSEO, which highlights the importance of following safety procedures during experiments (ILO2). It also addresses risk assessment scenarios, teaching students to evaluate chemical hazards (ILO3). Laboratory Apparatus Test is designed to assess students' ability to identify various common laboratory apparatus (ILO1).
Experiments (Lab Attendance and Performance)	ILO1, ILO2, ILO3, ILO4, ILO5	Experiments offer students hands-on experience with common laboratory equipment, enabling them to effectively recognize and utilize various tools (ILO1). By conducting standard procedures and risk assessment during experiments, students learn the correct experimental methods and how to evaluate potential hazards, promoting safety awareness (ILO2 & ILO3). Keeping records during experiments enhances their organizational skills and helps them understand the importance of data documentation (ILO4). Interpreting experimental results after experiments allows students to bridge the gap between theory and practice, enriching their understanding of physical and chemical phenomena (ILO5).

Lab Reports	ILO4, ILO5	Lab reports require students to systematically document their experimental data, thereby enhancing their record-keeping skills (ILO4). Through performing calculations and plotting graphs to interpret and analyze results in lab reports, students engage in critical thinking about physical and chemical phenomena (ILO5). This process empowers them to draw meaningful conclusions from their experiments, deepening their understanding of the underlying concepts.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
P	Pass	Fulfils all the course requirements below: 1. Achieve a score of at least 80% on both pre-course tests (Safety Test and Laboratory Apparatus Test). 2. Attend all experiments and obtain reasonable results. 3. Submit all lab reports with an average score of at least 5 points (out of a maximum of 10 points per report) and have no more than one report scoring below 4 points. (Since this course is an introductory one, the lab report format is designed to include only short answers, simple calculations, and graph plotting. This makes it straightforward to grade the lab reports according to marking schemes.)
F	Fail	Fails to fulfill any of the course requirements.

Course AI Policy

The use of Generative AI is permitted in this course.

Communication and Feedback

Assessment marks for lab reports will be communicated via Canvas within two weeks of submission. Feedback will include comments on incorrect answers. Students who have further questions about the feedback including marks should consult the Instructor/Instructional Assistants/Teaching Assistants within one week after the feedback is received.

Resubmission Policy

Resubmission of lab reports is allowed, but only the latest submission will be graded.

Late Submission Policy

Late submission of lab reports will incur a deduction of 2 points per day after the deadline, with any time less than a day counted as a full day.

Required Texts and Materials

Reference Book: James Hall, *Experimental Chemistry: An Atoms First Approach*, Brooks/Cole, Cengage Learning, **2012**.

Reference Book: J. A. Beran and Mark Lassiter, *Laboratory Manual for Principles of General Chemistry* (*11th edition*), Wiley, **2022**.

Other learning resources can be accessed through Canvas.

Academic Integrity

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CHEM 1051 Laboratory for General Chemistry A

2025–26 Spring

Course Outline

Instructor

Dr. CHEUNG Man Sing (sing@ust.hk)

Instructional Assistant (IA)

Mr. LAW Tommy Y. L. (chtommylaw@ust.hk)

Technical Officer

Ms. TSANG Tammy H. L. (chtammy@ust.hk)

Class Schedule

Section	Date	Time	Venue
LA1	Tuesday	10:30AM – 01:20PM	1004, CYT Building
LA2		01:30PM – 04:20PM	
LA3	Wednesday	10:30AM – 01:20PM	
LA4		01:30PM – 04:20PM	
LA5	Thursday	10:30AM – 01:20PM	
LA6		01:30PM – 04:20PM	

Course Information

Credit Units: 1

Pre-requisite: Nil

Co-requisite: CHEM 1011

Exclusion: Nil

Grade: P/F

Description:

This course is the laboratory class designed for students who are enrolled in CHEM 1011. With laboratory experience acquired in this course, students will be able to relate the physical and chemical principles and theories learned in the corresponding lecture course, perform basic chemical laboratory techniques, and develop their data analyzing skills.

Intended Learning Outcomes (ILOs)

On successful completion of the course, students will be able to:

Knowledge/Content Related:

1. recognize various kinds of equipment in chemistry laboratory
2. conduct standard laboratory procedures involved in basic chemistry experiments

Academic Skills/Competencies Related:

3. conduct risk assessments concerning the use of chemical substances in basic chemistry experiments
4. keep records of experimental work in basic chemistry experiments
5. interpret experimental results for physical and chemical phenomena in basic chemistry experiments

Assessment Scheme

Assessment	Assessing Course ILOs
Pre-course Tests	1, 2, 3
Lab Attendance and Performance	1, 2, 3, 4, 5
Lab Reports	4, 5

To pass the course, students have to get satisfactory performances in all abovementioned assessment tasks/activities.

Student Learning Resources

- Reference Book: James Hall, *Experimental Chemistry: An Atoms First Approach*, Brooks/Cole, Cengage Learning, **2012**.
- Reference Book: J. A. Beran and Mark Lassiter, *Laboratory Manual for Principles of General Chemistry* (*11th edition*), Wiley, **2022**.
- Other learning resources can be accessed through Canvas.

Teaching and Learning Activities

Laboratory: focus on experiments related to co-requisite course

Course Schedule

Keyword Syllabus:

- Laboratory safety
- Common laboratory apparatus
- Basic techniques for measurements in chemistry laboratory
- Solution stoichiometry and volumetric titration
- Acids and bases
- Acid-base equilibria
- Solubility and complex ion equilibria
- Spontaneity, entropy, and free energy
- Electrochemistry

The Hong Kong University of Science and Technology

CHEM 1052 Course Syllabus

Course Title: Laboratory for General Chemistry B

Course Code: CHEM 1052

Number of Credit: 1

Co-requisite: CHEM 1012 'General Chemistry B'

Name: Dr. TSE, Wai Pui Veronica

Email: chvaipui@ust.hk

Office Hours: By email appointments

Course Description

This course is the laboratory class designed for students who are enrolled in CHEM 1012. With laboratory experience acquired in this course, students will be able to relate the physical and chemical principles and theories learned in the corresponding lecture course, perform basic chemical laboratory techniques, and develop their data analyzing skills.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. recognize various kinds of equipment in chemistry laboratory
2. conduct standard laboratory procedures involved in basic chemistry experiments
3. conduct risk assessments concerning the use of chemicals in basic chemistry experiments
4. keep records of experimental work in basic chemistry experiments
5. interpret experimental results for physical and chemical phenomena in basic chemistry experiments
6. Work independently and collaborate in teamwork.

Assessment and Grading

This course will be assessed based on the fulfillment of specific requirements to pass, and grades will not be assigned using a curve. Detailed requirements for each assessment task are provided below.

Assessments:

Assessment Task	Contribution to Overall Course Grade (%)	Due Date*		
		LA1 & LA2	LA3 & LA4	LA5 & LA6
Pre-course Tests	-	10/02/2026	11/02/2026	12/02/2026
Experiment 1	-	24/02/2026	25/02/2026	26/02/2026
Lab Report 1	-	03/03/2026	04/03/2026	05/03/2026
Experiment 2	-	10/03/2026	11/03/2026	12/03/2026
Lab Report 2	-	17/03/2026	18/03/2026	19/03/2026
Experiment 3	-	24/03/2026	25/03/2026	26/03/2026
Lab Report 3	-	31/03/2026	01/04/2026	02/04/2026
Experiment 4	-	14/04/2026	15/04/2026	16/04/2026
Lab Report 4	-	21/04/2026	22/04/2026	23/04/2026
Experiment 5	-	28/04/2026	29/04/2026	30/04/2026
Lab Report 5	-	05/05/2026	06/05/2026	07/05/2026

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Pre-course Tests (Safety Test and Laboratory Apparatus Test)	ILO1, ILO2, ILO3	Safety Test is designed based on Safety Orientation provided by HSEO, which highlights the importance of following safety procedures during experiments (ILO2). It also addresses risk assessment scenarios, teaching students to evaluate chemical hazards (ILO3). Laboratory Apparatus Test is designed to assess students' ability to identify various common laboratory apparatus (ILO1).
Experiments (Lab Attendance and Performance)	ILO1, ILO2, ILO3, ILO4, ILO5, ILO6	Experiments offer students hands-on experience with common laboratory equipment, enabling them to effectively recognize and utilize various tools (ILO1). By conducting standard procedures and risk assessment during experiments, students learn the correct experimental methods and how to evaluate potential hazards, promoting safety awareness (ILO2 & ILO3). Keeping records during experiments enhances their organizational skills and helps them understand the importance of data documentation (ILO4). Interpreting experimental results after experiments allows students to bridge the gap between theory and practice, enriching their

		understanding of physical and chemical phenomena (ILO5). Also emphasizes the importance of independent work and teamwork (ILO6).
Lab Reports	ILO4, ILO5	Lab reports require students to systematically document their experimental data, thereby enhancing their record-keeping skills (ILO4). Through performing calculations and plotting graphs to interpret and analyze results in lab reports, students engage in critical thinking about physical and chemical phenomena (ILO5). This process empowers them to draw meaningful conclusions from their experiments, deepening their understanding of the underlying concepts.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
P	Pass	Fulfils all the course requirements below: 1. Achieve a score of at least 80% on both pre-course tests (Safety Test and Laboratory Apparatus Test). 2. Attend all experiments and obtain reasonable results. 3. Submit all lab reports with an average score of at least 5 points (out of a maximum of 10 points per report) and have no more than one report scoring below 4 points. (Since this course is an introductory one, the lab report format is designed to include only short answers, simple calculations, and graph plotting. This makes it straightforward to grade the lab reports according to marking schemes.)
F	Fail	Fails to fulfill any of the course requirements.

Course AI Policy

The use of Generative AI is permitted in this course.

Communication and Feedback

Assessment marks for lab reports will be communicated via Canvas within two weeks of submission. Feedback will include comments on incorrect answers. Students who have further questions about the feedback including marks should consult the Instructor/Instructional Assistants/Teaching Assistants within one week after the feedback is received.

Resubmission Policy

Resubmission of lab reports is allowed, but only the latest submission will be graded.

Late Submission Policy

Late submission of lab reports will incur a deduction of 2 points per day after the deadline, with any time less than a day counted as a full day.

Required Texts and Materials

Reference Book: James Hall, *Experimental Chemistry: An Atoms First Approach*, Brooks/Cole, Cengage Learning, **2012**.

Reference Book: J. A. Beran and Mark Lassiter, *Laboratory Manual for Principles of General Chemistry* (*11th edition*), Wiley, **2022**.

Other learning resources can be accessed through Canvas.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

The Hong Kong University of Science and Technology

CHEM 2155 Syllabus, ILOs, Assessments and Grading

Course Title: Fundamental Organic Chemistry Laboratory

Course Code: CHEM 2155

Number of Credit(s): 1

Pre-requisite: CHEM1051 or CHEM 1052

Co-requisite: CHEM 2110 or CHEM 2111

Exclusion: CHEM 2150, CHEM 2550

Name: Prof. CHAN, Ho Wai Dennis

Email: chanhw@ust.hk

Office Hours: By email appointments

Course Description

This is the laboratory course designed for non-CHEM students who enrolled in CHEM 2110 or CHEM 2111. Students will perform a series of organic experiments related to the theories learnt in the related lecture courses. Students will be trained to practice a wide range of fundamental organic laboratory techniques, operate chemical instruments, relate the physical and chemical principles and theory in practice, and develop their data interpretation and analytical skills. For non-CHEM students in programs that designate this course as required course/specified elective only.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Conduct analysis and interpretation of experimental data related to organic experiments. [ILO1]
2. Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment. [ILO2]
3. Conduct standard laboratory procedures involved in synthetic and instrumental work related to organic experiments. [ILO3]
4. Equip with hands on experiences in the operation of chemical instrumentation [ILO4]
5. Demonstrate self-awareness, to interact with other people in teamwork, and to work independently. [ILO5]

Assessment and Grading

Assessment Task	Contribution to Overall Course grade	Due date
Chem Lab Safety Assignment	5%	Week 2
Performance (purification of solids)	6%	LA2&LA3: Week 2 / LA1: Week 4 *
Performance (purification of liquids)	6%	LA2&LA3: Week 5 / LA1: Week 6 *
Performance (separation techniques)	6%	LA2&LA3: Week 7 / LA1: Week 8 *
Performance (synthesis)	6%	LA2&LA3: Week 9 / LA1: Week 10 *
Performance (characterizations)	6%	LA2&LA3: Week 11 / LA1: Week 12 *
Performance (purification of solids)	6%	LA2&LA3: Week 2 / LA1: Week 4 *
Lab report (purification of liquids)	6%	LA2&LA3: Week 5 / LA1: Week 6 *
Lab report (separation techniques)	6%	LA2&LA3: Week 7 / LA1: Week 8 *
Lab report (synthesis)	6%	LA2&LA3: Week 9 / LA1: Week 10 *
Lab report (characterizations)	6%	LA2&LA3: Week 11 / LA1: Week 12 *
Examination (summative assessment)	35%	T.B.A.

* Assessment marks for individual assessed tasks will be released within two weeks after the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Chem Lab Safety Assignment	ILO2	These tasks assess students' ability to assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment (ILO 2).
Performance	ILO2, ILO3, ILO4, ILO5	These tasks assess students' ability in assessing the risk of chemical substances and laboratory procedures (ILO2), applying the knowledge to conduct analysis and interpretation of experimental data related to organic experiments (ILO3), and their proficiency in the operation of chemical instrumentation (ILO4), while also emphasizing the importance of working both independently and as part of a team (ILO5).
Lab Report	ILO1, ILO2	These tasks evaluate students' capacity to grasp organic laboratory course materials encompassing the essentials of organic laboratory techniques and chemical instrumentation and data interpretation (ILO1) and assess their ability to assess and manage the risk of chemical substances and laboratory procedures (ILO2).
Examination	ILO1, ILO2	This task evaluates students' capacity to grasp laboratory course materials encompassing the essentials of organic laboratory techniques and chemical instrumentation and data interpretation (ILO1) and assess their ability to assess and manage the risk of chemical substances and laboratory procedures (ILO2).

Grading Rubrics

Criteria	Excellent (9-10/10)	Good (7-8/10)	Satisfactory (5-6/10)	Marginal (3-4/10)	Fail (0-2/10)	Mapping to course ILO(s)
Chem Lab Safety Assignment	Demonstrates exceptional understanding of the importance of risk assessment and management. Shows meticulous attention to accuracy in assessing chemical hazards.	Provides a clear understanding of the importance of risk assessment and management. Shows a solid grasp of accuracy in assessing chemical hazards.	Offers some understanding of the importance of risk assessment and management. Shows some degree of accuracy in assessing chemical hazards.	Lacks in-depth understanding of the importance of risk assessment and management. Shows very limited accuracy in assessing chemical hazards.	Fails to meet minimum expectations for understanding of the importance of risk assessment and management. Lacks accuracy in assessing chemical hazards.	ILO2
Performance	Demonstrates thorough understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in organic and instrumental work related to organic materials, and (iii) conducting analysis and interpretation of experimental data related to organic materials. Demonstrates strong ability to work independently and collaborate effectively in teamwork	Demonstrates a clear and detailed understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in organic and instrumental work related to organic materials, and (iii) conducting analysis and interpretation of experimental data related to organic materials. Demonstrates ability to work independently and collaborate effectively in teamwork	Demonstrates some understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in organic and instrumental work related to organic materials, and (iii) conducting analysis and interpretation of experimental data related to organic materials. Demonstrates some level of ability to work independently and collaborate effectively in teamwork	Lacks in-depth understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in organic and instrumental work related to organic materials, and (iii) conducting analysis and interpretation of experimental data related organic materials. Shows very limited ability to work independently and collaborate effectively in teamwork	Fails to meet minimum expectations for understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in organic and instrumental work related to organic materials, and (iii) conducting analysis and interpretation of experimental data related to organic materials. Shows almost no ability to work independently and collaborate effectively in teamwork	ILO2, ILO3, ILO4, ILO5
Laboratory Report	Demonstrates thorough understanding of the essential facts, principles and theories across organic chemistry. Connects these elements to relevant course concepts and theories, showcasing a strong understanding of the material.	Provides a clear and detailed understanding of the essential facts, principles and theories across organic chemistry. Makes connections to course material.	Demonstrate some understanding of the essential facts, principles and theories across organic chemistry. Connections to course material may be limited.	Lacks in-depth understanding of the essential facts, principles and theories across organic chemistry. Shows very limited connections to course material.	Fails to meet minimum expectations for understanding of the essential facts, principles and theories across organic chemistry. Shows almost no connection to any course material.	ILO1, ILO2
Examination	Demonstrates thorough understanding of the essential facts, principles and theories across organic chemistry. Connects these elements to relevant course concepts and theories, showcasing a strong understanding of the material.	Provides a clear and detailed understanding of the essential facts, principles and theories across organic chemistry. Makes connections to course material.	Offers some understanding of the essential facts, principles and theories across organic chemistry. Connections to course material may be limited.	Lacks in-depth understanding of the essential facts, principles and theories across organic chemistry. Shows very limited connections to course material.	Fails to meet minimum expectations for understanding of the essential facts, principles and theories across organic chemistry. Shows almost no connection to any course material.	ILO1, ILO2

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates exceptional understanding of laboratory procedures and concepts. Shows meticulous attention to detail in experimental work, analysis, and reporting. Consistently produces high-quality results and exhibits advanced problem-solving skills.
B	Good Performance	Displays a solid grasp of laboratory techniques and concepts. Completes experiments accurately and effectively, with well-organized data collection and analysis. Shows proficiency in applying theoretical knowledge to practical situations.
C	Satisfactory Performance	Shows a satisfactory understanding of laboratory procedures and concepts. Conducts experiments with some degree of accuracy and efficiency, though improvements could be made in data interpretation and analysis. Meets basic requirements but lacks depth in experimentation.
D	Marginal Pass	Demonstrates limited understanding and application of laboratory techniques and concepts. Shows inconsistencies in experimental procedures and data handling. Requires significant enhancement in accuracy, precision, and adherence to safety protocols.
F	Fail	Fails to meet minimum expectations for laboratory work. Exhibits significant deficiencies in understanding, execution of experiments, and safety practices. Lacks basic skills in data collection, analysis, and reporting.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include explanations why the answer is incorrect. Students who have further questions about the feedback should consult the corresponding TA within seven days after the feedback is received.

Required Texts and Materials

- No specific textbook
- Course materials (lab manuals, tutorial videos, etc.) can be downloaded/viewed by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).

Additional Resources

Reference books:

[1] Kenneth L. Williamson, Katherine M. Masters, *Macroscale and Microscale Organic Experiments* 7th edition, Australia: Cengage ©**2017**. OR

[2] Kenneth L. Williamson, Katherine M. Masters, *Macroscale and Microscale Organic Experiments* 6th edition, Australia: Cengage ©**2011**.

Course AI Policy

In lab reports, students are allowed to use generative artificial intelligence (AI) to aid them in any manner. However, students must give proper credit for any use of generative AI.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Keyword syllabus

- Solubility of Organic Solids
- Recrystallization of Organic Solids
- Simple Distillation of Organic Liquids
- Fractional Distillation of Organic Liquids
- Separation of Organic Components from a Mixture
- Isolation of an Organic Component by Liquid-Liquid Extractions
- Organic Synthesis
- Nucleophilic Substitution
- Melting Point Measurement
- Infra-Red Spectroscopy for Liquid and Solid Samples

CHEM 2155 Fundamental Organic Chemistry Laboratory

2026 spring

Course Outline

1. Instructor

Prof. CHAN, Ho Wai Dennis (email: chanhw@ust.hk)
Office Room 4528; Tel: 3469-2099

2. Technical support staff / Teaching Assistant:

Technicial support staff:

LAU, Chun Tak Disney (email: disney@ust.hk)
CHAN, Ka Lok Kelvin (email: chkelvin@ust.hk)
WONG, Yuet Yan Claire (email: chclaire@ust.hk)
CHOI, Chai Yu Edwin (email: edwinchoi@ust.hk)
Contact Details: CYT-1003 and CYT-1004; Tel: 3469-2611 or 3469-2612

Teaching Assistant:

Name: [to be provided on a separate file on Canvas]

3. Meeting Time and Venue:

Date/Time:	Tue	LA1 10:30 – 13:20
	Tue	LA2 13:30 – 16:20
	Tue	LA3 10:30 – 13:20
Venue:	CYT-1003 and CYT-1004 (1/F, CYT buidling)	

4. Course Description

Credit Points: 1
Pre-requisites: CHEM 1051 or CHEM 1052
Co-requisites: CHEM 2110 or CHEM 2111
Exclusions: CHEM 2150, CHEM 2550
Brief Information/synopsis:

This is the laboratory course designed for non-CHEM students who enrolled in CHEM 2110 or CHEM 2111. Students will perform a series of organic experiments related to the theories learnt in the related lecture courses. Students will be trained to practice a wide range of fundamental organic laboratory techniques, operate chemical instruments, relate the physical and chemical principles and theory in practice, and develop their data interpretation and analytical skills. For non-CHEM students in programs that designate this course as required course/specified elective.

5. Intended Learning Outcomes (ILOs)

Upon completion of the course, students should be able to:

1	Conduct analysis and interpretation of experimental data related to organic experiments.
2	Assess and manage the risk of chemical substances and laboratory procedures, and to evaluate their potential impact on the environment.
3	Conduct standard laboratory procedures involved in synthetic and instrumental work related to organic experiments.
4	Equip with hands on experiences in the operation of chemical instrumentation.
5	Demonstrate self-awareness, to interact with other people in teamwork, and to work independently.

6. Assessment Scheme

Graded from A+ to F. In lab. reports, you are allowed to use generative artificial intelligence (AI) to aid you in any manner. However, you must give proper credit for any use of generative AI.

Assessment items	Weight	ILOs to be assessed
Chem Lab Safety Assignment	5%	2
Performance	30% (5×6%)	2, 3, 4, 5
Lab Report	30% (5×6%)	1, 2
Examination	35%	1, 2

** Overall score for getting a Pass (i.e. Grade C- or above): 50%*

7. Student Learning Resources

Reference books:

[1] Kenneth L. Williamson, Kathrine M. Maters, "*Macroscale and Microscale Organic Experiments*" 7th edition, Australia: Cengage ©2017; or

[2] Kenneth L. Williamson, Kathrine M. Maters, "*Macroscale and Microscale Organic Experiments*" 6th edition, Australia: Cengage ©2011.

** Other course materials can be obtained from Canvas (https://canvas.ust.hk). Please log in using your ITSC username and password.*

8. Teaching and Learning Activities

Scheduled activities: 2 hr 50 min (Tutorial + Laboratory work)

9. Keyword syllabus:

- Recrystallization of Organic Solids
- Distillation of Organic Liquids
- Separation of Organic Components from a Mixture
- Isolation of an Organic Component
- Organic Synthesis
- Nucleophilic Substitution
- Melting Point Measurement
- Infra-Red Spectroscopy

The Hong Kong University of Science and Technology

UG Course Syllabus

Analytical Chemistry

CHEM 2311

3 Credits

Pre-requisites: CHEM 1010 OR CHEM 1011 OR CHEM 1012

Exclusions: CHEM 2310

Name: Ian D. WILLIAMS

Email: chwill@ust.hk

Office Hours: Various

Course Description

This course covers fundamental and practical aspects of elemental and molecular chemical analysis, including titrimetric, electrical, optical and mass spectroscopic methods, analytical separations by chromatography, NMR and X-ray methods. For non-CHEM students in programs that designate this course as required course/specified elective only.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the main methods of elemental and molecular analysis for major, minor and trace components of a sample.

2. Understand the underlying principles of these analytical techniques and their appropriate quantification for measurement of analytes.

3. Apply critical thinking skills to evaluate choice of analytical methods for particular samples, based on strengths and limitations of the method, nature and quantity of sample, end user requirements.

4. Analyze the reporting of scientific data and the appropriate consideration of likely sources of error and interferences.

5. Demonstrate the ability to report scientific measurements with appropriate accuracy and precision through careful calibration and repeat measurements.

Assessment and Grading

Attendance/ In-class Quiz (10%):

Participation is encouraged through use of the i-PRS system is used to both record in-class attendance and give bonus points through correct responses. This also gives feedback on difficulties or whether key concepts are being well understood.

Homeworks (15%):

• Two homeworks for assessment are provided one before/ one after MT exam. These are conducted via Canvas using question banks. These homeworks will measure individual learning outcomes on key concepts and theories in the course and provide feedback to students, with correct responses shown with comment.

Homeworks involve use of complex calculations including spreadsheets and statistics that cannot be readily examined in MT or Final exam.

Mid-Term Exam (30%): Shorter Mid term exam covers material from lectures 1-16 useful to provide early warning of students at risk/ in difficulty. Make up exam provided in case of valid excuse for absence.

Final (45%): This longer exam covers specific material from second part of course as well as requiring understanding of principles covered in early lectures on scientific measurements, accuracy, precision, significant figures.

Summary Table Assessment Task	**Contribution to Course grade (%)**	**Due date**
Attendance/ in class quizzes	10%	Throughout term
Homework 1	7.5%	09/03/2026
Mid-term exam	30%	30/03/2026
Homework 2	7.5%	28/04/26
Final exam	45%	May 2026 tba by ARO

The Hong Kong University of Science and Technology

UG Course Syllabus

Fundamental Analytical Chemistry Laboratory

CHEM 2355

1 Credit

Pre-requisites: CHEM 1051 OR CHEM 1052

Corequisite: CHEM 2310 OR CHEM 2311

Exclusions: CHEM 2350, CHEM 2555

Name: Dr Joanne W T Tung

Email: jwttung@ust.hk

Office: Rm 4541

Course Description

This is the laboratory course corresponding to the lecture courses of CHEM 2310 and CHEM 2311. Experiments covered in this course will be closely connected with the topics covered in the lecture courses, including calibration principle, and some basic optical and chromatographic instrumental techniques. For non-CHEM students in programs that designate this course as a required course/specified elective only.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the essential facts, principles and theories across the area of analytical chemistry.
2. Formulate and analyze a wide range of chemical problems by applying relevant chemical principles.
3. Analyze and interpret experimental data, critically assess and extract useful data from it.
4. Conduct standard laboratory procedures involved in instrumental and experimental work.
5. Operate a range of chemical instrumentation with adequate hands-on experiences.
6. Assess and manage the risks of chemical substances and laboratory procedures by evaluating their potential impact on the environment.
7. Demonstrate self-awareness, work independently and collaborate effectively with other people in a team.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed mapping for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Lab Reports	60%	According to the individual experiment deadline
Lab Quizzes	30%	According to the individual experiment deadline
Lab Performance	10%	According to the individual experiment deadline

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Reports	ILO1, ILO2, ILO3, ILO4, ILO7.	This task assesses students' ability to explain and apply analytical chemistry principles and theories (ILO 1); evaluate their ability to apply the relevant chemical principles to analyze a wide range of analytical chemistry problems (ILO 2), and interpret and critically assess and explain experimental data obtained from the experiments and be able to explain from the obtained experimental results (ILO 3); assess their understanding of the experimental or instrumental works in order to obtain experimental data for their reports (ILO 4), and work independently (ILO 7).
Lab Quizzes	ILO1, ILO2, ILO3, ILO4.	The quizzes assess students' knowledge to explain and apply analytical chemistry principles and theories (ILO 1); evaluate their ability to apply analytical chemistry principles to solve a wide range of analytical chemical problems (ILO 2); and their understanding of the meaning of experimental results (ILO 3) and understanding of the experimental procedure or instrumental works (ILO 4).
Lab Performance	ILO4, ILO5, ILO6, ILO7	Lab performance assess students' ability to conduct instrumental and experimental works correctly according to the given laboratory

		procedure (ILO4), operate a range of chemical instruments correctly (ILO 5), evaluate the risks of chemicals and can safely dispose chemicals (ILO 6), work independently and collaborate with other fellow students in laboratory (ILO 7).

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of the analytical experiments. Exhibits a high capacity of understanding, analyzing and critically assessing the experimental and instrumental works, going beyond the requirements of the learning goals. Displays high motivation to learn and the ability to work effectively with others.
B	Good Performance	Shows good knowledge and understanding of the analytical experiments, and demonstrate ability in analyzing and evaluating the experimental and instrumental works.
C	Satisfactory Performance	Possesses adequate knowledge of the analytical experiments, and shows understanding of the core concept of the experimental works.
D	Marginal Pass	Has threshold knowledge of the analytical experiments, and has potential to achieve the skills to make basic judgments.
F	Fail	Demonstrates insufficient understanding of the analytical experiments, and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

There is no restriction on the use of generative AI in this course. Nevertheless, if students choose to use these tools, please use them ethically. Your submitted reports will be checked by Turnitin on canvas for detecting copying works. If you are found directly copy the answers generated by these tools, or cross copying from one another for these same answers, this falls in to plagiarism and dishonesty, the whole report will be zero mark.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within 10 working days of submission. Feedback on assignments will included. Students who have questions about the feedback including marks should raise during the data handling session or the next lab session.

Late Submission Policy

To ensure fairness for students who submit reports on time, a penalty for late submission is listed as follows:

- Late submission for every 12 hours, 10% of total marks deduction will be applied.

- Late penalty will be compounded at 10% mark deduction for every 12 hours lateness.
- For lateness that is less than 12 hours, it will be counted as one 12 hours.

Recommended Texts and Materials

- Skoog D A, West D M, Holler F J, ***Fundamentals of Analytical Chemistry***, 9th Ed, Brooks/Cole, 2013.
- Daniel C. Harris, Charles A. Lucy, *Quantitative Chemical Analysis*, 10th Ed, Macmillan Learning, 2020

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

The Hong Kong University of Science and Technology
UG Course Syllabus

Organic Chemistry II

CHEM 3120
3 Credits
Pre-requisites: CHEM 2110

Name: Dr. Jianwei Sun — Dr. Yao Luo

Office: CYT6010 — Office: CYT6014
Telephone: 2358 7351 — Telephone: 2358 7376
E-mail: sunjw@ust.hk — E-mail: yaoluo@ust.hk

Teaching Assistants:
LIN, Jie
LIU, Ruoyu
WANG, Xinhao

Lecture Time: Monday, 15:00 - 16:20
Friday, 10:30 - 11:50

Venue: Rm 2404 (Lift 17/18)

Course Description

Continuation of CHEM 2110. Dienes, resonance and aromaticity; electrophilic aromatic substitution and nucleophilic aromatic substitution; benzylic and allylic reactivity; the chemistry of carbonyl compounds and carboxylic acid derivatives; the chemistry of amines; pericyclic reactions.

CHEM3120 is the second half of a two-semester, introductory level organic chemistry course designed for chemistry and biochemistry majors. The complete course will prepare students for further studies in organic chemistry and/or biochemistry. Topics to be covered include IR, MS, and NMR spectroscopy; dienes, resonance and aromaticity; electrophilic aromatic substitution and nucleophilic aromatic substitution; benzylic and allylic reactivity; the chemistry of carbonyl compounds and carboxylic acid derivatives; the chemistry of amines; pericyclic reactions. The complete two-semester course will prepare students for further studies in organic chemistry and/or biochemistry

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Recognize fundamentals of organic chemistry including structures, reaction mechanisms, and transformations of carbon-derived compounds.

2. Explain the essential facts, principles, and theories of organic chemistry.

3. Demonstrate awareness of organic chemistry topics relevant to social and daily life.

4. Formulate and analyze mechanisms and products of organic transformations by applying organic chemistry principles.

Assessment and Grading

1. Midterm examination, 40%
2. Final examination, 60%

Textbook

"*Organic Chemistry*" 8th edition by J. McMurry; Brooks/Cole, Thomson Learning, Inc. 2012
"*Study Guide and Student Solutions Manual for McMury's Organic Chemistry, 8th Edition*" by Susan McMurry, Brooks/Cole, Thomson Learning, Inc.

Syllabus:

Week 1	Feb. 2	*Chapter 12. Mass Spectrometry & Infrared Spectroscopy (1)*
	Feb. 6	*Chapter 12. Mass Spectrometry & Infrared Spectroscopy (2)*
Week 2	Feb. 9	*Chapter 13. Nuclear Magnetic Resonance Spectroscopy (1)*
	Feb. 13	*Chapter 13. Nuclear Magnetic Resonance Spectroscopy (2)*
Week 3	Feb. 16	*No class (swap with mid-term exam)*
	Feb. 20	*No class (swap with mid-term exam)*
Week 4	Feb. 23	*Chapter 14. Conjugated Dienes and UV Spectroscopy (1)*
	Feb. 27	*Chapter 14. Conjugated Dienes and UV Spectroscopy (2)*
Week 5	Mar. 2	*Chapter 15. Benzene and Aromaticity*
	Mar. 6	*Chapter 16. Electrophilic Aromatic Substitution (1)*
Week 6	Mar. 9	*Chapter 16. Electrophilic Aromatic Substitution (2)*
	Mar. 13	*A Preview of Carbonyl Compounds*
		Chapter 19. Aldehydes/Ketones: Nucleophilic Addition Reaction (1)
Week 7	Mar. 16	*Chapter 19. Aldehydes/Ketones: Nucleophilic Addition Reaction (2)*
	Mar. 20	*Tutorial (1)*

Mar. 21 (Sat.) Mid-Term Exam, 16:00 – 18:00
Covering Chapters 12-16 and 19, inclusive; Venue: **TBD**

Week 8	Mar. 23	*Chapter 20. Carboxylic Acids and Nitriles*
	Mar. 27	*Chapter 21. Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions (1)*
Week 9	Mar 30	*Chapter 21. Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions (2)*
	Apr. 10	*Chapter 22. Carbonyl Alpha-Substitution Reactions (1)*
Week 10	Apr. 13	*Chapter 22. Carbonyl Alpha-Substitution Reactions (2)*
	Apr. 17	*Chapter 23. Carbonyl Condensation Reactions (1)*
Week 11	Apr. 20	*Chapter 23. Carbonyl Condensation Reactions (2)*
	Apr. 24	*Chapter 24. Amines and Heterocycles (1)*
Week 12	Apr. 27	*Chapter 24. Amines and Heterocycles (2)*
Week 13	May 4	*Chapter 30. Orbitals and Organic Chemistry: Pericyclic reactions (1)*
	May 8	*Chapter 30. Orbitals and Organic Chemistry: Pericyclic reactions (2)*

Final Exam, to be announced

Supporting Reading Materials and Solution Manual

Call Number	QD251.3 .M364 2008 c.1-3
AUTHOR	McMurry, John.
TITLE	Organic chemistry / John McMurry.
EDITION	7th ed.
IMPRINT	Belmont, CA : Thomson Brooks/Cole, c2008.
# Copies:	3 copies

Call Number	QD251.3 .M3642 2008 c.1-3
AUTHOR	McMurry, Susan
TITLE	Study guide and student solutions manual for McMurry's Organic chemistry
EDITION	7th ed.
IMPRINT	Australia : Thomson Brooks/Cole, c2008.
# Copies:	3 copies

Call Number	QD251.3 .M364 2004 c.1-4
AUTHOR	McMurry, John.
TITLE	Organic chemistry / John McMurry.
EDITION	6th ed.
IMPRINT	Pacific Grove, CA : Brooks/Cole, c2004.
# Copies:	4 copies

Call Number	QD251.3 .M3642 2004 c.1-4
AUTHOR	McMurry, Susan.
TITLE	Study guide and solutions manual for McMurry's Organic chemistry
EDITION	6th ed.
IMPRINT	Pacific Grove, CA : Brooks/Cole, c2004.
# Copies:	5 copies

Call Number	QD251.2 .M43 2000
AUTHOR	McMurry, John.
TITLE	Organic chemistry / John McMurry.
EDITION	5th ed.
IMPRINT	Pacific Grove, CA : Brooks/Cole, c2000.
# Copies:	4 copies

Call Number	QD251.2 .M432 2000
AUTHOR	McMurry, Susan.
TITLE	Study guide and solutions manual for McMurry's Organic chemistry,
EDITION	5th ed.
IMPRINT	Pacific Grove, Calif. : Brooks/Cole, c2000.
# Copies	4 copies

Call Number	QD251.2 M43 1996
AUTHOR	McMurry, John
TITLE	Organic Chemistry / John McMurry
EDITION	4th ed.
IMPRINT	Pacific Grove: Brooks/Cole Pub. Co., c1996.
# Copies:	4 copies

Call Number	QD251.2 M432 1996
AUTHOR	McMurry, Susan
TITLE	Study guide and solution manual for organic chemistry, fourth edition / Susan McMurry
IMPRINT	Pacific Grove, CA: Brooks/Cole Pub. Co., c1996.
# Copies:	4 copies

The Hong Kong University of Science and Technology
UG Course Syllabus

Inorganic Chemistry II
CHEM 3220
3 Credits
Pre-requisites: CHEM 2210

Name: Prof. Yangjian Quan
Email: chyjquan@ust.hk
Office Hours: By email appointments

Class schedule
Lecture: Tuesday (9:00-10:20 am), Thurday (9:00-10:20 am), Rm LG3008

Course website: http://canvas.ust.hk/

Course Description

Mechanism of inorganic reactions, organometallic and bioinorganic chemistry, catalysis.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Recognize fundamentals of chemistry including structures, reactivity and properties of inorganic compounds and states of matters.

2. Explain essential facts, principles, and theories of inorganic chemistry such as crystal field theory and the 18-electron rule.

3. Demonstrate awareness of chemical topics relevant to social and daily life.

Assessment and Grading

Quizzes:	5% x 3 (15%)
Assignments:	5% x 2 (10%)
Midterm exam:	30%
Final exam:	42%
Others (e.g. PRS, participation in class and tutorials):	3%

Textbook:
Inorganic Chemistry, International edition, by M. Weller et al., OUP (2018)

Reference book:
"*Inorganic Chemistry*", 4th ed., by C. E. Housecroft and A. G. Sharpe, Pearson (2012) [online access to the 3rd edition]

Course Contents

(1) Coordination Chemistry

- Classification of ligands, naming of inorganic complexes
- Crystal field theory: d-orbital splitting for octahedral, tetrahedral, tetragonal and square planar complexes
- Factors that affect the size of crystal field splitting, spectrochemical series
- High-spin and low-spin electron configurations, ligand field stabilization energies
- Geometry of d^8 complexes: square planar versus tetrahedral geometry
- Spectral properties of metal ions: d-d and charge-transfer transitions
- Magnetic properties of transition metal ions
- Correlation of enthalpies of hydration of metal ions and lattice enthalpies of metal oxides with ligand field stabilization energies
- Coordination equilibria, stepwise and overall formation constants, Irving-Williams series
- Chelate and macrocyclic effects, applications of chelate ligands
- Jahn-Teller distortion of Cu(II) compounds
- Molecular orbital energy level diagrams of metal complexes, comparison of MO theory with crystal field theory

(2) Organometallic chemistry of transition elements

- The 18-electron rule: rationale, examples, and exceptions
- Electron count: ionic and covalent models
- Carbonyl compounds: bonding and structures, factors affecting IR C-O stretching frequencies of metal carbonyls, synthesis and reactions of metal carbonyls, acidity of metal carbonyl hydride compounds
- Ligands that are isoelectronic with CO (NO^+, CN^-, N_2)
- Alkene and alkyne compounds
- Organometallic reactions: oxidative addition, reductive elimination, and migratory insertion
- Homogeneous catalysis: catalytic cycles for Rh-catalyzed alkene hydrogenation, Co-catalyzed alkene hydroformylation, metal-catalyzed polymerization of alkenes, Pd-catalyzed cross-coupling reactions
- Selectivity of catalytic reactions, Tolman cone angles of phosphines

(3) Main group hydride compounds

- Classification of hydride compounds: saline, covalent, and metallic hydrides
- Electron-deficient, electron-precise and electron-rich hydrides: bonding, structures, and stability, acid-base properties
- Synthesis and reactions of hydride compounds

(4) Main group alkyl/aryl compounds

- Thermodynamic and kinetic stabilities of metal alkyl compounds
- Trends of M-C bond energies for transition and main group alkyl compounds
- Bonding and structures of main group alkyl compounds
- Inert pair effects
- Synthesis and reactions of main group alkyl compounds

(5) Element-element multiple bonds

- Trends of element-element sigma and pi bonds
- N_2 vs. P_4, O_2 vs. S_8
- Multiple bonds between heavier elements, bonding and structure of Sn_2R_4
- $d\pi$-$p\pi$ interactions in $R_3Si\text{-}O\text{-}SiR_3$ and $R_3P{=}O$

(6) Inorganic rings and cages

- Inorganic rings: borazine, polysiloxane, phosphazenes
- Inorganic cages
- Boranes and carboranes: *closo*, *nido* and *arachno* polyhedra, Wades rules

The Hong Kong University of Science and Technology

UG Course Syllabus

Course Information

- **Course Title:** Instrumental Analysis
- **Course Code:** CHEM 3320
- **Credits:** 3
- **Pre-requisite:** CHEM 2310

Instructor Information

- **Instructor:** Prof. Hongkai WU
- **Email:** chhkwu@ust.hk
- **Office Hours:** By appointment

Course Description

This course is a continuation of CHEM 2310. It introduces advanced instrumental methods in chemical analysis, with particular emphasis on electrochemical techniques, mass spectrometry, optical spectroscopy, and surface characterization methods.

Course Synopsis

Building on the foundational knowledge acquired in CHEM 2310—where students develop practical and theoretical understanding of classical analytical techniques (e.g., titrimetry, electroanalytical methods, spectroscopy, and chromatographic separations such as GLC and HPLC)—this course focuses on modern, instrument-based approaches to chemical analysis.

Key topics include electrochemical analysis, mass spectrometry, optical spectroscopic techniques, and surface characterization methods. Emphasis is placed on both the fundamental principles and real-world applications of these techniques. The course aims to equip students with a comprehensive understanding of contemporary analytical tools that are widely used in chemistry, materials science, environmental monitoring, and biomedical research.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. **Demonstrate Understanding**
   Explain the fundamental principles and operational mechanisms of modern instrumental analytical techniques, including electrochemical methods, mass spectrometry, optical spectroscopy, and surface analysis.
2. **Apply Knowledge**
   Interpret and evaluate analytical data, and describe the applications of instrumental methods in solving chemical problems at an undergraduate level.
3. **Communicate Effectively**
   Present and explain concepts related to instrumental analysis clearly and effectively in both oral and written forms, tailored to scientific and general audiences.
4. **Prepare for Advanced Study**
   Apply foundational knowledge of instrumental techniques to support future laboratory work, research projects, and advanced studies in chemistry and related disciplines.

Assessment and Grading

Component	Description	Weight
Homework	Approximately 5–7 problem sets assigned throughout the semester (non-graded, for practice and learning reinforcement)	0%
Midterm Examination	2-hour closed-book written examination	45%
Final Examination	2-hour closed-book written examination	55%

The Hong Kong University of Science and Technology
UG Course Syllabus

Physical Chemistry II
CHEM 3420
3 Credits
Pre-requisites: CHEM 2410

Name: Prof. Jonathan E. Halpert
Email: xxxxxx@ust.hk
Office Hours: by Appointment

Teaching Assistants:
Gideon MA xxxxxx@connect.ust.hk
Xingyu CHEN xxxxxx@connect.ust.hk
Andrew AU xxxxxx@connect.ust.hk
Jimmy CHOY xxxxxx@connect.ust.hk

Lectures:

Monday & Wednesday	9:00pm–10:20 am	Rm CYTG009A

Office Hours:

Professor	Wednesday	10:30 am – 11:30 am	Room 4505 (Lift 25/26)
TAs	Monday	11:00 am – 12:00 am	Room 1401A (SciHome)

Course Website:
available to enrolled students on CANVAS

COURSE DESCRIPTION AND BRIEF SYNOPSIS:

Basic quantum theory, atomic and molecular structure, equilibrium statistical thermodynamics. CHEM 3420: Physical Chemistry II aims to provide the students with a basic knowledge of the concepts, mathematics, and results of quantum mechanics and its application to chemical systems. Specifically, we will cover topics including the principles and mathematics tools in quantum mechanics, one-dimensional problems, particle-in-box, harmonic oscillator, angular momentum theory, spin, and introduction to methods of modern electronic structure theory, with applications in atomic and molecular structures, spectroscopy, and chemical bonding.

INTENDED LEARNING OUTCOMES (ILOs)

By the end of this course, students should be able to:

1. Establish a recognition of the fundamentally important role of physical chemistry in molecular science.

2. Gain a better understanding of the relationship between physical chemistry and other sub-areas of chemistry.

3. Develop an appreciation of the relationship between chemistry and physics, mathematics and other disciplines in science.

4. Assess and judge some of the pressing societal issues in health, environment, and new technologies from the point of view of physical chemistry.

issues in health, environment, and new technologies from the point of view of Physical Chemistry.

ASSESSMENT AND GRADING

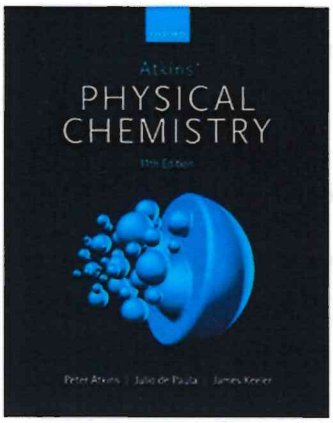
Midterm Exam	50%
Final Exam	40%
Assignments	10%

Notes:

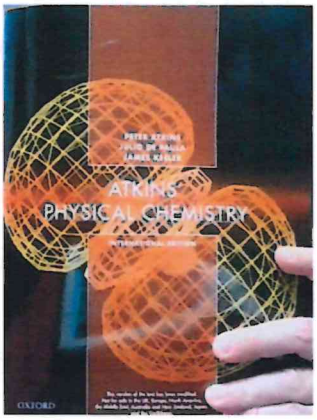
- Midterm Exam and Final Exam are in-class, open-book, open notes examinations.
- Assignments: There will be three sets of homework assignments in total. You should complete all three assignments (follow guidelines from instructor).

TEXTBOOK

Physical Chemistry, 11th International Edition, by P. W. Atkins and J. de Paula, Oxford University Press, 2018. *(both US and international editions are fine)*



11th Ed.



11th International Ed.

STUDENT REQUIREMENT

- Students need to be familiar with the syllabus and the class schedule, and be aware of the course requirements and progress.
- Students need to check the course website (https://canvas.ust.hk/courses/xxxxTBD) and their UST e-mails on regular basis. All assignments, slides and any other course materials will be posted on the course website. Furthermore, course announcements will also be make on the course website and/or via UST e-mail.
- Students are required to be familiar with HKUST Academic Integrity Policy (http://www.ust.hk/vpaao/integrity/). These policies will be strictly enforced in this course to keep academic honesty.
- Students need to follow proper classroom ethics, so that we can make a comfortable learning environment to each and every student in the class.

COURSE SCHEDULE

Week 1	Introduction & Topic 1: Introduction to Quantum Theory *Textbook: Chapter 7*
	Topic 1: Introduction to Quantum Theory (continued)
Week 2	Topic 1: Introduction to Quantum Theory (continued) Topic 1: Introduction to Quantum Theory (continued)
Week 3	No class (Lunar New Year's Day)
Week 4	Topic 2: The Quantum Theory of Motion – Translation *Textbook: Chapter 8A.* Topic 2: The Quantum Theory of Motion – Translation (continued)
Week 5	Topic 2: The Quantum Theory of Motion – Vibration *Textbook: Chapter 8B.* Topic 2: The Quantum Theory of Motion – Vibration (continued)
Week 6	Topic 2: The Quantum Theory of Motion – Rotation *Textbook: Chapter 8C* Topic 2: The Quantum Theory of Motion – Rotation (continued)
Week 7	Topic 2: The Quantum Theory of Motion – Rotation (continued) Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms *Textbook: Chapter 9A*
Week 8	Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms (continued) No class (Good Friday)
	Topic 3: Atoms – Atomic Structure of Hydrogen-like atoms (continued)
Week 9	**Midterm Exam** (TBD)

	No class (Mid-term Break)
Week 10	Topic 3: Atoms – Atomic Structure of many electron atoms *Textbook: Chapter 9B* Topic 3: Atoms – Atomic Spectra *Textbook: Chapter 9C*
Week 11	Topic 4: Molecules – Valence Bond theory *Textbook: Chapter 10A* Topic 4: Molecules – Valence Bond theory (continued)
Week 12	Topic 4: Molecules – Valence Bond theory (continued) Topic 4: Molecules – Molecular Orbital theory *Textbook: Chapter 10B-D*
Week 13	Topic 4: Molecules – Molecular Orbital theory (continued) Topic 4: Molecules – Hückel theory *Textbook: Chapter 10B-D*
	Finish lectures and Review
May 16-29	**Final Exam** (covers Topic 3 & 4) Arranged by the university

Updated at Jan 28, 2026

The Hong Kong University of Science and Technology

CHEM 3550 Syllabus, ILOs, Assessments and Grading

Course Title: Synthetic Chemistry Laboratory II

Course Code: CHEM 3550

Number of Credit(s): 2

Pre-requisite: CHEM 2550

Co-requisite: CHEM 3120 and CHEM 3220

Exclusion: nil

Name: Prof. CHAN, Ho Wai Dennis

Email: chanhw@ust.hk

Office Hours: By email appointments

Course Description

This is the laboratory course corresponding to the lecture courses CHEM 3120 and CHEM 3220. The topics of experiments covered in the laboratory course will be related to those taught in the lecture courses. For CHEM students only.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Describe the fundamentals of organic and inorganic chemistry [ILO1]
2. Assess and manage the risks of organic and inorganic chemical substances and laboratory procedures [ILO2]
3. Conduct analysis and interpretation of experimental data of synthetic chemistry [ILO3]
4. Conduct standard laboratory procedures involved in fundamental chemical synthesis and instrumental work [ILO4]
5. Operate a range of chemical instrumentation [ILO5]
6. Work independently and collaborate in teamwork [ILO6]

Assessment and Grading

Summary:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Laboratory Quizzes	30%	Week 2, 5, 7, 9 and 11 *
Laboratory Performance	20%	Week 2, 5, 7, 9 and 11 *
Product /Results	10%	Week 2, 5, 7, 9 and 11 *
Laboratory Reports	40%	Week 4, 6, 8, 10 and 12 *

* Assessment marks for individual assessed tasks will be released within two weeks after the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Quizzes	ILO1, ILO2, ILO3	These tasks assess students' comprehension of fundamental concepts in both organic and inorganic chemistry (ILO1), as well as their awareness of the potential hazards associated with these chemical substances (ILO2).
Laboratory Performance	ILO2, ILO3, ILO4, ILO5, ILO6	These tasks assess students' ability to manage the risks of chemical substances and laboratory procedures (ILO 2) and to apply the knowledge learned in lecture courses to analyze data (ILO3). They also assess students' proficiency in conducting laboratory techniques (ILO4) and handling equipment (ILO5), while also emphasizing the importance of working both independently and as part of a team (ILO6).
Product /Results	ILO4, ILO5	These tasks demonstrate our students' capacity to grasp laboratory techniques [ILO4] and effectively utilize equipment. (ILO5).
Lab Reports	ILO1, ILO2, ILO3, ILO4, ILO5	These tasks evaluate students' capacity to grasp the lecture and laboratory materials encompassing the essentials of organic and inorganic chemistry (ILO1), risk assessment and management in a chemistry laboratory [ILO2]. This includes data analysis and interpretation (ILO3), conduction of standard chemical synthesis [ILO4] and handling the operation of instruments (ILO5).

Grading Rubrics

Criteria	Excellent (9-10/10)	Good (7-8/10)	Satisfactory (5-6/10)	Marginal (3-4/10)	Fail (0-2/10)	Mapping to course ILO(s)
Lab quizzes	Demonstrates thorough understanding of the essential facts, principles and theories across organic and inorganic chemistry. Demonstrate thorough understanding in management of risk in laboratory scenario and interpretation of experimental data. Connect these elements to relevant course concepts and theories, showcasing a strong understanding of the course material.	Demonstrates a clear and detailed understanding of the essential facts, principles and theories across organic and inorganic chemistry. Demonstrate understanding in management of risk in laboratory scenario and interpretation of experimental data. Make connections to course material. and interpretation of experimental data	Demonstrates some understanding of the essential facts, principles and theories across organic and inorganic chemistry. Demonstrate limited understanding in management of risk in laboratory scenario and interpretation of experimental data. Show limited connections to course material.	Lacks in-depth understanding of the essential facts, principles and theories across organic and inorganic chemistry. Demonstrate very limited understanding in management of risk in laboratory scenario and interpretation of experimental data. Shows very limited connections to course material.	Fails to meet minimum expectations for understanding of the essential facts, principles and theories across organic and inorganic chemistry. Show almost no understanding in management of risk in laboratory scenario and interpretation of experimental data. Shows almost no connection to any course material.	ILO1, ILO2, ILO3

Laboratory Performance	Demonstrates thorough understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in synthetic and instrumental work, and (iii) conducting analysis and interpretation of experimental data. Demonstrates excellent competency in (i) conducting chemical synthetic works and instrumental work, and (ii) operating instruments. Demonstrates strong ability to work independently and collaborate effectively in teamwork	Demonstrates a clear and detailed understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in synthetic and instrumental work, and (iii) conducting analysis and interpretation of experimental data. Demonstrates competency in (i) conducting chemical synthetic works and instrumental work, and (ii) operating instruments. Demonstrates ability to work independently and collaborate effectively in teamwork	Demonstrates some understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in synthetic and instrumental work, and (iii) conducting analysis and interpretation of experimental data. Demonstrates limited competency in (i) conducting chemical synthetic works and instrumental work, and (ii) operating instruments. Demonstrates some level of ability to work independently and collaborate effectively in teamwork	Lacks in-depth understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in synthetic and instrumental work, and (iii) conducting analysis and interpretation of experimental data. Demonstrates very limited competency in (i) conducting chemical synthetic works and instrumental work, and (ii) operating instruments. Shows very limited ability to work independently and collaborate effectively in teamwork	Fails to meet minimum expectations for understanding of the skills for (i) managing the risk of chemical substances and laboratory procedures, (ii) conducting standard laboratory procedures in synthetic and instrumental work, and (iii) conducting analysis and interpretation of experimental data. Demonstrates almost no competency in (i) conducting chemical synthetic works and instrumental work, and (ii) operating instruments. Shows almost no ability to work independently and collaborate effectively in teamwork	ILO2, ILO3, ILO4, ILO5, ILO6
Product / Results	Demonstrates excellent competency in the skills in conducting standard laboratory procedures in synthetic and instrumental work and operation of instruments	Demonstrates competency in the skills in conducting standard laboratory procedures in synthetic and instrumental work and operation of instruments	Demonstrates limited competency in of the skills in conducting standard laboratory procedures in synthetic and instrumental work and operation of instruments.	Shows very limited competency in the skills in conducting standard laboratory procedures in synthetic and instrumental work and operation of instruments.	Fails to meet minimal expectations for competency in the skills in conducting standard laboratory procedures in synthetic and instrumental work and operation of instruments.	ILO4, ILO5
Laboratory Reports	Demonstrates thorough understanding of (i) the essential facts, principles and theories across organic and inorganic chemistry, (ii) how the risk of chemical substances and laboratory procedures are managed, (iii) how and why standard laboratory procedures in synthetic and instrumental work are done, (iv) how analysis and interpretation of experimental data are done, (v) how instruments are operated to obtain meaningful measurement.	Provides a clear and detailed understanding of (i) the essential facts, principles and theories across organic and inorganic chemistry, (ii) how the risk of chemical substances and laboratory procedures are managed, (iii) how and why standard laboratory procedures in synthetic and instrumental work are done, (iv) how analysis and interpretation of experimental data are done, (v) how instruments are operated to obtain meaningful measurement.	Demonstrate some understanding of (i) the essential facts, principles and theories across organic and inorganic chemistry, (ii) how the risk of chemical substances and laboratory procedures are managed, (iii) how and why standard laboratory procedures in synthetic and instrumental work are done, (iv) how analysis and interpretation of experimental data are done, (v) how instruments are operated to obtain meaningful measurement.	Lacks in-depth understanding of (i) the essential facts, principles and theories across organic and inorganic chemistry, (ii) how the risk of chemical substances and laboratory procedures are managed, (iii) how and why standard laboratory procedures in synthetic and instrumental work are done, (iv) how analysis and interpretation of experimental data are done, (v) how instruments are operated to obtain meaningful measurement.	Fails to meet minimum expectations for understanding (i) the essential facts, principles and theories across organic and inorganic chemistry, (ii) how the risk of chemical substances and laboratory procedures are managed, (iii) how and why standard laboratory procedures in synthetic and instrumental work are done, (iv) how analysis and interpretation of experimental data are done, (v) how instruments are operated to obtain meaningful measurement.	ILO1, ILO2, ILO3, ILO4, ILO5

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates exceptional understanding of laboratory procedures and concepts. Shows meticulous attention to detail in experimental work, analysis, and reporting while following appropriate safety practices. Consistently produces high-quality results and exhibits advanced problem-solving skills.
B	Good Performance	Displays a solid grasp of laboratory techniques and concepts. Completes experiments accurately and effectively while following appropriate safety practices, with well-organized data collection and analysis. Shows proficiency in applying theoretical knowledge to practical situations.
C	Satisfactory Performance	Shows a satisfactory understanding of laboratory procedures and concepts. Conducts experiments with some degree of accuracy and efficiency, though improvements could be made in data interpretation and analysis. Meets basic requirements but lacks depth in experimentation, and safety practice.
D	Marginal Pass	Demonstrates limited understanding and application of laboratory techniques and concepts. Shows inconsistencies in experimental procedures and data handling. Requires significant enhancement in accuracy, precision, and adherence to safety protocols.
F	Fail	Fails to meet minimum expectations for performing laboratory work. Exhibits significant deficiencies in understanding, execution of experiments, and safety practices. Lacks basic skills in data collection, analysis, and reporting.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include explanations why the answer is incorrect. Students who have further questions about any feedback and scores should consult the corresponding TA within seven days after the feedback is received.

Required Texts and Materials

- No specific textbook
- Course materials (lab manuals, tutorial videos, etc.) can be downloaded/viewed by logging in to the CANVAS website using your ITSC username and password (https://canvas.ust.hk).

Additional Resources

Reference books:

[1] Kenneth L. Williamson, Katherine M. Masters, Macroscale and Microscale Organic Experiments 7th edition, Australia: Cengage ©2017. (or the 6th edition ©2011)

[2] A. I. Vogel, (editor), Vogel's Textbook of Practical Organic Chemistry 5th edition, London: Longman Scientific & Technical ©1989.

[3] Lutz F. Tietze, Theophil Eicher, Ulf Diederichsen, Reactions and Syntheses: In the Organic Chemistry Laboratory, Weinheim: Wiley ©2015. [available online / HKUST library]

[4] J. Derek Woollins, Inorganic Experiments 3rd edition, Weinheim: Wiley ©2010.

Course AI Policy

In lab reports, students are allowed to use generative artificial intelligence (AI) to aid them in any manner. However, students must give proper credit for any use of generative AI.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Keyword syllabus

- Separation of an Organic Mixture by Column Chromatography
- Purification of Organic Compounds
- Chemical Resolution of a Racemic Mixture
- Electrophilic Aromatic Substitutions
- Regioselectivity of Aromatic Substitutions
- Synthesis of Schiff Bases
- Reductive Amination
- Synthesis of Transition Metal Complexes
- Characterization of Isomers of Transition Metal Complexes
- Measurement of Magnetic Susceptibility
- Polarimetry of Chiral Organic Compounds
- Measurement of Infrared Spectra
- Measurement of ^{1}H Nuclear Magnetic Resonance Spectra
- Measurement of ^{13}C Nuclear Magnetic Resonance Spectra

The Hong Kong University of Science and Technology

UG Course Syllabus

Molecular Characterization Chemistry Laboratory II

CHEM 3555

2 Credits

Pre-requisites: CHEM 2555

Corequisites: CHEM 3320 AND CHEM 3420

Name: Dr Joanne W T Tung

Email: jwttung@ust.hk

Office: Rm 4541

Course Description

This is the laboratory course corresponding to the lecture courses CHEM 3320 and CHEM 3420. The topics of experiments covered in the laboratory course will be related to those taught in the lecture courses, such as quantum chemistry, chemical instrumental analysis, etc.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the essential facts, principles and theories in the area of analytical and physical chemistry.
2. Formulate and analyze a wide range of chemical problems by applying chemical principles.
3. Analyze and interpret experimental data and extract useful data from it.
4. Conduct standard laboratory procedures involved in instrumental work.
5. Operate a range of chemical instrumentation with adequate hands-on experiences.
6. Assess and manage the risks of chemical substances and laboratory procedures by evaluating their potential impact on the environment.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed mapping for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Lab Reports	45%	According to the individual experiment deadline
Lab Quizzes	35%	According to the individual experiment deadline
Lab Performance	20%	According to the individual experiment deadline

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Reports	ILO1, ILO2, ILO3, ILO4, ILO7.	This task assesses students' ability to explain and apply analytical and physical chemistry principles and theories (ILO 1); evaluate their ability to apply the relevant chemical principles to analyze a wide range of analytical and physical chemistry problems (ILO 2), and interpret and critically assess and explain experimental data obtained from the experiments and be able to explain from the obtained experimental results (ILO 3); assess their understanding of the experimental or instrumental works in order to obtain experimental data for their reports (ILO 4), and work independently (ILO 7).
Lab Quizzes	ILO1, ILO2, ILO3, ILO4.	The quizzes assess students' knowledge to explain and apply analytical and physical chemistry principles and theories (ILO 1); evaluate their ability to apply analytical and physical chemistry principles to solve a wide range of analytical chemical problems (ILO 2); and their understanding of the meaning of experimental results (ILO 3) and understanding of the experimental procedure or instrumental works (ILO 4).
Lab Performance	ILO4, ILO5, ILO6, ILO7	Lab performance assess students' ability to conduct instrumental and experimental works correctly according to the given laboratory procedure (ILO4), operate a range of chemical instruments correctly (ILO 5), evaluate the risks of chemicals and can safely dispose chemicals (ILO 6), work

		independently and collaborate with other fellow students in laboratory (ILO 7).

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of the analytical and physical experiments. Exhibits a high capacity of understanding, analyzing and critically assessing the experimental and instrumental works, going beyond the requirements of the learning goals. Displays high motivation to learn and the ability to work effectively with others.
B	Good Performance	Shows good knowledge and understanding of the analytical and physical experiments, and demonstrate ability in analyzing and evaluating the experimental and instrumental works.
C	Satisfactory Performance	Possesses adequate knowledge of the analytical and physical experiments, and shows understanding of the core concept of the experimental works.
D	Marginal Pass	Has threshold knowledge of the analytical and physical experiments, and has potential to achieve the skills to make basic judgments.
F	Fail	Demonstrates insufficient understanding of the analytical and physical experiments, and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

There is no restriction on the use of generative AI in this course. Nevertheless, if students choose to use these tools, please use them ethically. Your submitted reports will be checked by Turnitin on canvas for detecting copying works. If you are found directly copy the answers generated by these tools, or cross copying from one another for these same answers, this falls in to plagiarism and dishonesty, the whole report will be zero mark.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within 10 working days of submission. Feedback on assignments will included. Students who have questions about the feedback including marks should raise during the data handling session or the next lab session.

Late Submission Policy

To ensure fairness for students who submit reports on time, a penalty for late submission is listed as follows:

- Late submission for every 12 hours, 10% of total marks deduction will be applied.
- Late penalty will be compounded at 10% mark deduction for every 12 hours lateness.
- For lateness that is less than 12 hours, it will be counted as one 12 hours.

Recommended Texts and Materials

- Peter Atkins, Julio de Paula, James Keeler, *Atkins' Physical Chemistry*, 11th Ed, Oxford University Press, 2018.
- Daniel C. Harris, Charles A. Lucy, *Quantitative Chemical Analysis*, 10th Ed, Macmillan Learning, 2020.
- Skoog D. A., Holler F. J., *Principles of Instrumental Analysis*, 7th Ed., Australia: Cengage Learning, 2007.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

The Hong Kong University of Science and Technology

UG Course Syllabus

Introduction to AI for Chemistry

CHEM 3030

4 Credits (Weekly 3 hours lecture and 1 hour tutorial)

Pre-requisites: CHEM 1012 AND (MATH 1005 OR MATH 1006 OR MATH 1012 OR MATH 1013 OR MATH 1020 OR MATH 1023)

Name: Prof. Sherry Lixue CHENG

Email: lixuecheng@ust.hk

Office Hours: By email appointments

Course description

- **Level**: Undergraduate elective for students major or minor in Chemistry
- **Prerequisites**: General Chemistry I & II, Elementary math courses. Suggested to know basic python coding but not required. Suitable for 2nd or 3rd year UG students that have declared or intended to declare Chemistry related programs.
- **Brief Information**: This is a science-popularization course targeting for UG students from chemistry programs that introduces how AI is transforming chemistry, from predicting molecular properties to designing new drugs and materials. Through few example AI for Chem tool demos, brief literature reading, and hands-on activities, students explore mainstream AI tools for chemistry in four key modules: AI for molecules, AI for materials, AI for biomolecules, and AI for physical chemistry (electronic structure and molecular dynamics). Along the way, the course will also highlight two core philosophies of AI for Chem: data-driven modeling and physics-informed modeling, equipping students with both intuition and inspiration for how AI accelerates chemical discovery. *Note that, this course will not deep dive into the details about the models but focus on the current applications in AI for Chem*

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Demonstrate basic knowledge & understanding of how AI can boost discoveries in chemistry.
2. Identify the key research areas of AI for Chemistry and become familiar with commonly used tools and resources.
3. Gain hands-on experiences of using available AI for Chemistry tools in the format of graphical user interface and databases.
4. Practice and strengthen academic communication skills, including presenting and writing within a chemistry + AI context.
5. Develop collaborative working skills & a team-oriented mindset through group discussions and projects.
6. Cultivate curiosity in AI for Chem & develop motivation to pursue AI x Chemistry in the future.

Assessment and Grading

Note that AI detection and plagiarism checking will be performed for all the writing assignments.

- **In-class quiz (15%):** Multichoice problems on the basics introduced in the lecture. Assessed **5** times in the TA sessions, **3% each**. ILO-1, ILO-2
- **Written assignment (15%):** Each student needs to work on an individual short essay (around 300-500 words) on the literature contents introduced in each module (Molecules, Biomolecules, & Materials). **5% each**. ILO-2, ILO-4
- **Team project (55%):** Each team (2-3 students) needs to pick one specific topic from the four major AI for Chem directions introduced in the course. The project should be a (1) literature review or (2) exploration of a specific chemistry problem using AI tools introduced in the class
  - **Project report (30%):** The project report needs to be written around 2000 to 5000 words, written in a proper format with ACS style citations. The ACS template will be provided.
    - Team formation & topic chosen: We suggest picking topics from **Molecules, Biomolecules and Materials**. Please let us know ahead if you want to pick Physical Chemistry.
    - **In-progress report (10%)**
    - **Final report (20%)**
    - ILO-3, ILO-4, ILO-5
  - **Presentation (25%):** Each team needs to provide a poster (see the CHEM3030 AI for Chem Student Poster Session) or an in-class presentation. Each team needs to submit your poster or presentation slides ahead. The lecture, TA & invited professors will grade all the posters based your contents and presentation performances. ILO-4, ILO-5
- **Course participation (10%)**: Assessed by the lecture and TA. Extra credits are available randomly for active participations. ILO-5, ILO-6
- **Peer evaluation (5%)**: For the **Team project**, students will provide a peer evaluation on the contributions and engagements of their peers working in the same team. CILO-5

Student Learning Resources:

Currently, there is no good educational resources across the world but hopefully our course materials will finally become a textbook. Your AI tools are also your resources :)

Course Topics and Proposed Schedule

- **Basic machine learning knowledge (02/02-2026 – 27/02/2026)**
  - What is AI? Difference between AI, ML, deep learning, and data science
  - Supervised learning and regression task
  - Unsupervised learning, feature extraction and representations
  - Brief introduction to reinforcement learning, generative modeling, and large language model for science
- **AI for molecules (27/02-2026 – 18/03/2026)**
  - Molecular representations: SMILES, fingerprints, graphs, 3D structures
  - AI for molecular property prediction, reactions and retrosynthesis
  - Hands-on demo: use Bohrium as a tool for molecular explorations prediction
- **AI for biomolecules (18/03-2026 – 10/04/2026)**
  - Representing Proteins and DNA: sequences and structures
  - AI for protein structure prediction, drug discovery and enzyme design
  - Hands-on demos: Explore RCSB PDB and UniProt databases, visualize protein structures predicted by AlphaFold DB (AF2), and structure predictions with AlphaFold server (AF3)
- **AI for materials (10/04-2026 – 30/04/2026)**
  - Representing crystals, polymers, and catalysts
  - High-throughput screening with AI + databases (Materials Project, Open Catalyst Project)
  - AI for crystals, catalysis and material design
  - Hands-on demo: explore Materials Project database & CSLLM tool
- **AI for physical chemistry (30/04-2026 – 11/05/2026) (Challenging)**
  - Physics-informed vs purely data-driven models
  - AI for spectroscopy, molecular dynamics and quantum chemistry

CHEM 3030 AI for Chem Student Poster Session

At the end of the semester, we will host a poster session, which is open to all the chemistry department personals, including UG/PG students and professors. This will be a great chance for you to introduce your learning outcomes to other people and seek for research opportunities. We will announce the detailed location and time during the semester.

Course Assessments

Assessments	Contents	Scores	Due Date
TA Quiz #1	Quiz on basic ML knowledge	30	2/27/26
TA Quiz #2	Quiz on AI for molecules	30	3/18/26
Team project Opening	Team project formation and topic chosen	0	3/21/26
Writing #1	Short essay on AI for molecules	50	3/22/26
TA Quiz #3	Quiz on AI for biomolecules	30	4/10/26
Writing #2	Short essay on AI for biomolecules	50	4/15/26
Team project Progress Report	Team project Progress Report submission	100	4/20/26
TA Quiz #4	Quiz on AI for materials	30	4/30/26
Writing #3	Short essay on AI for materials	50	5/2/26
TA Quiz #5	Quiz on AI for physical chemistry	30	5/11/26
Team project Poster & Presentation	Team project Poster Session & In-room Presentation	250	From 4/5/26 to 8/5/29 (No TA session)
Team project Final Report	Team project Final Report submission	200	5/15/26
Peer evaluation		50	5/15/26
Course participation		100	Entire semester
Total		**1000**	Entire semester

Hong Kong University of Science and Technology
UG Course Syllabus

Medicinal Chemistry
CHEM 4130
3 Credits
Pre-requisites: CHEM 3120

Name: Professor Hugh NAKAMURA
Office: Rm. 6143; Tel: 3469-2552
Email: hnakamura@ust.hk

TA: Mr. Xilun Wu
Email: xwudu@connect.ust.hk

Lecture Time: Tuesday, Thursday 09:00-10:20

Venue: Rm. 5402 (Lift17/18)

Course Description

This course will introduce the chemistry principles underlying the drug-target interaction and the development of drugs. One of its major topics is the molecular basis of the interaction of medicinal compounds with various biomolecules and the effect of their structure on their therapeutic activities. In addition, this course will discuss the pharmacokinetics and pharmacodynamics properties of therapeutic agents and how these properties are related to their chemical structure. Moreover, another focus of this course is the chemical strategies to discover and optimize lead compounds that can eventually develop into agents of therapeutic values. For CHEM students and students with instructor's approval only.

Summary and Objectives

CHEM4130 is an introductory course in medicinal chemistry for undergraduate students in chemistry and biochemistry. The course provides an overview of fundamental concepts and methodologies in drug discovery and development prior to in vivo studies.

A strong foundation in organic chemistry is required, as students will explore:
- The molecular basis of life
- Enzyme catalysis and protein–protein interactions
- Enzyme inhibition and strategies to modulate protein–protein interactions
- Principles of drug-like molecule design

- Combinatorial chemistry and organic synthesis
- High-throughput screening for lead identification
- Lead optimization approaches
- Bioisosteres in medicinal chemistry

Core knowledge of reaction mechanisms, functional group transformations, and stereochemistry will be emphasized as the basis for advanced drug design strategies. Special attention will be given to direct functional group modifications and the synthesis and application of bioisosteres, which play a central role in medicinal chemistry research.
Through interactive discussions, students will develop skills in the rapid synthesis of bioactive compounds, strengthen their molecular design capabilities, and enhance their ability to present scientific ideas effectively.

Course Website
http://canvas.ust.hk/, use the user name and password of your email account to log on.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Understand and recognize the fundamental chemical principles underlying the interaction of small molecule therapeutic agents with human and other hosts.

2. Explain the essential facts, principles, and theories of the therapeutic agents in disease processes.

3. Understand the favorable and unfavorable interactions of living organisms with the small molecule therapeutic agents to better appreciate the significance of regulation of drug safety and prevention of drug abuse.

4. Formulate chemical strategies to discover hit and lead compounds in search of therapeutic agents against a disease target.

5. Formulate synthetic strategy for optimization of the lead compounds in order to develop them into agents of therapeutic values.

Assessment and Grading

(1) Midterm exam (40%)
(2) Final exam (50%)
(3) Attendance (10%): Attendance will be taken from Feb 10.
(4) Bonus points (ca. 5%): Active questions during the lectures will be awarded bonus points. Please feel encouraged to ask questions or provide comments during the sessions.

Course Materials: The all course materials are uploaded on CANVAS. From selective textbooks, research reviews, and research papers.

Lecture videos: The lecture videos are uploaded on CANVAS.

Reading Materials:

1. Graham L. Patrick, An introduction to medicinal chemistry / 5th & 6th editions; ISBN: 0199697396, Oxford University Press, 2013, 2017.
2. Alan Fersht, Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, 1999, W. H. Freeman and Company, New York.
3. Alan Fersht, Series in Structural Biology : Volume 9, Structure and Mechanism in Protein Science--A Guide to Enzyme Catalysis and Protein Folding, https://doi.org/10.1142/10574, August 2017.
4. Thomas E. Creighton, Proteins-Structures and Molecular Properties, ISBN 0-7167-2317-4, 1993, W. H. Freeman and Company.
5. Richard B. Silverman, The organic chemistry of enzyme-catalyzed reactions, San Diego, California; London: Academic Press, 2000.
6. Benjamin Lewin, Genes- 5th, 6th, 7th and 8th editions, ISBN 0131238264 (8th Ed. International ed.), Oxford University Press.
7. Lubert Stryer, Biochemistry-3rd, 4th, and 5th editions, W. H. Freeman and Company, New York.
8. William O. Foye (Editor), Principles of Medicinal Chemistry, 3rd-7th Edition, Lea & Febiger, London.Alex Gringauz, Introduction to Medicinal Chemistry, ISBN 0-471-18545-0, 1997, Wiley-VCH, Inc.
10. Graham L. Patrick, An Introduction to Medicinal Chemistry, 2nd Edition, ISBN 0-19-850533, 2001, Oxford University Press.
11. Graham L. Patrick, An introduction to medicinal chemistry / Graham L. Patrick ; with a chapter on combinatorial and parallel synthesis; co-authored by John Spence, ISBN 9780199234479, Oxford University Press, 2009.
12. Graham L. Patrick, An introduction to medicinal chemistry / Graham L. Patrick, 5th-7th edition; ISBN: 0199697396 and 9780198866664, Oxford University Press, 2013-2023.
13. Review and primary research articles of various sources.

Syllabus

Dates	**Subjects**
Feb. 3	Introduction of Medicinal Chemistry (case studies in academic)
Feb. 5	Introduction of Medicinal Chemistry (case studies in academic)
Feb. 10	A comprehensive understanding of the affinity of pharmaceuticals to cell membranes and target proteins. Biososteres and their formation. (1)
Feb. 12	A comprehensive understanding of the affinity of pharmaceuticals to cell membranes and target proteins. Biososteres and their formation. (2)
Feb. 17	*No class, Lunar New Year's Day*
Feb. 19	*No class, Lunar New Year's Day*
Feb. 24	Understanding the structure of the lipid bilayer and its interaction with target proteins and small molecules. Cell membrane translocation of substituted biososters, their subsequent binding to target proteins, and their understanding. (1)
Feb. 26	Understanding the structure of the lipid bilayer and its interaction with target proteins and small molecules. Cell membrane translocation of substituted biososters, their subsequent binding to target proteins, and their understanding. (2)
Mar. 3	Understanding LogP, and the influence of lipophilicity, water solubility, and sp3 properties on pharmaceuticals and their mechanisms of action, for the design of pharmaceutical products. Cell membrane translocation of ortho-substituted biososters and heterocyclic biososters, their subsequent binding to target proteins, and their understanding. (1)
Mar. 5	Understanding LogP, and the influence of lipophilicity, water solubility, and sp3 properties on pharmaceuticals and their mechanisms of action, for the design of pharmaceutical products. Cell membrane translocation of ortho-substituted biososters and heterocyclic biososters, their subsequent binding to target proteins, and their understanding. (2)
Mar. 10	Practical application of biososters to pharmaceuticals and improvement of the physicochemical properties of existing drugs through their introduction. (1)
Mar. 12	Practical application of biososters to pharmaceuticals and improvement of the physicochemical properties of existing drugs through their introduction. (2)
Mar. 17	Review and Recap Before the Midterm Exam.
Mar. 19	Tutorial – ORQ (Open Round Questions) by TAs. (The same room as the lecture) (9:00-10:20) (attendance optional)

Mar. 24	TA Tutorial (The same room as the lecture) (9:00-10:20) (attendance optional)
Mar. 26	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding of the DNA intercalation mechanism and drug design/synthesis. (1)
Mar. 31	**Midterm Exam** (The same room as the lecture) (9:00-10:20)
Apr. 2	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding of the DNA intercalation mechanism and drug design/synthesis. (2)
Apr. 7	*No class, Midterm break*
Apr. 9	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the roles of anticancer drugs and infectious disease treatments. Understanding the binding of small molecule drugs to genes and the mechanisms involved. (1)
Apr. 14	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the roles of anticancer drugs and infectious disease treatments. Understanding the binding of small molecule drugs to genes and the mechanisms involved. (2)
Apr. 16	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the Topoisomerase inhibition mechanism and DNA alkylating agents/design/synthesis. (1)
Apr. 21	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the Topoisomerase inhibition mechanism and DNA alkylating agents/design/synthesis. (2)
Apr. 23	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the DNA Metallating agents, DNA Chain cutters, and DNA Chain terminator: mechanisms /design/synthesis. (1)
Apr. 28	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the DNA Metallating agents, DNA Chain cutters, and DNA Chain terminator: mechanisms /design/synthesis. (2)
Apr. 30	RNA/DNA targeted drugs (anti-cancer, antibacterial drugs). Understanding the DNA Metallating agents, DNA Chain cutters, and DNA Chain terminator: mechanisms /design/synthesis. (3)
Mar 5	TA Tutorial (attendance optional)
May 26	**Final Exam**

*Please note that the lecture schedule may change slightly depending on the progress of the lectures or other circumstances. Please pay attention to our announcements.

The Hong Kong University of Science and Technology

UG Course Syllabus

Intermediate Inorganic Chemistry

CHEM 4240

3 Credits

Pre-requisites: CHEM 3220

Instructor

Name: Wa-Hung Leung

Contact Details: e-mail: chleung@ust.hk, ext. 7360, office: Rm 4538

Teaching Assistant

Name: Mr. Xuyang YAN

Contact Details: e-mail: xyanbc@connect.ust.hk, ext. 7374

Meeting Time and Venue

Lectures:

Date/Time: Wednesday and Friday, 16:30-15:50

Venue: Rm 1410

Tutorials:

Date/Time: To be arranged

Venue: To be arranged

Course Description

Selected advanced topics in inorganic chemistry including reaction mechanisms, electronic spectroscopy, lanthanide chemistry, bioinorganic chemistry and catalysis.

Brief Information/synopsis:

Intermediate Inorganic Chemistry is a 3-credit elective course for all Year 3 chemistry undergraduate students. The curriculum is designed to cover a range of topics on bonding, structure, reactivity, and spectroscopy of inorganic complexes, with intended learning outcomes focusing on developing students' intellectual and generic skills.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

ILO1: Recognize fundamentals of chemistry, bonding, structures, reactivity of inorganic complexes and clusters.

ILO2: Explain essential facts, principles and theories of inorganic chemistry, e.g., spectral properties of inorganic complexes, mechanisms of inorganic reactions, Wades' rules.

Assessment Scheme

a. Examination duration: 3 hrs
b. Percentage of coursework, examination, etc.:

Assessment	Assessing Course ILOs
10% by assignment	1, 2
8% by quizzes	1,2
40% by mid-term test	1,2
42% by final exam	1,2

c. The grading is assigned based on students' performance in assessment tasks/activities.

Student Learning Resources

Recommended Reading:

Text(s):

"Inorganic Chemistry", international edition, by M. Weller *et al.*, OUP (2018)

Teaching and Learning Activities

Scheduled activities: 3 hrs (lecture)

Course Schedule

Keyword Syllabus:

- Inorganic reaction mechanisms: substitution (square planar and octahedral complexes) and redox reactions (outer-sphere and inner-sphere electron transfer).
- Electronic spectra: Russell-Saunder terms. Hund's rules. Spectral terms. Selection rules for electronic transitions. Tanabe-Sugano diagrams. Nephelauxetic effect. Ligand-field spectra. Charge-transfer spectra. Intervalence charge-transfer.
- Metal-metal multiple bonds: Electron configurations and bond order of M_2X_8 complexes.
- Metal atom clusters: Lower and higher nuclearity carbonyl clusters. Magic numbers. Wade's rules. Capping rule.
- Lanthanides chemistry: Electron configurations. Trends of atomic and ionic properties. Oxidation states. Spectral and magnetic properties. Applications.
- Special topics: Metal-ligand multiple bonds, metal-oxo complexes, and photochemistry of inorganic complexes

The Hong Kong University of Science and Technology

UG Course Syllabus

Separation Science

CHEM 4330

3 Credits

Pre-requisites: CHEM 2310 or CHEM 2311

Name: Prof. Simon W. Chan

Email: chanwan@ust.hk

Office Phone Number: 2358-7370

Office Hours: Walk-in (Rm 4517) *or* by appointment

Course TA: Mr. WONG, Ka-Wa; email: kwwongbx@connect.ust.hk

***Lecture Hour*:** Tue & Thu 10:30AM - 11:50AM

***Venue*:** *Rm 5402, Lift 17-18*

Course Description

This course aims to provide an in-depth understanding of the working principles in separating substances by chemical and physical techniques. Topics in this course include: sample preparation for chromatographic analysis; instrumentation for gas and liquid chromatography; mass spectrometry, and etc. Applications (case studies) of various separation techniques for forensic, environmental, biological, pharmaceutical, food and drink analyses will be provided as illustrating examples.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the essential facts, principles and theories across the four principal areas of chemistry, i.e. analytical, organic, inorganic and physical.
2. Demonstrate awareness of chemical topics relevance to social and daily life such as environmental issues.
3. Formulate and analyze a wide range of analytical and synthetic chemical problems by applying chemical principles.
4. Communicate effectively both orally and in writing with professionals and/or lay audience.

Experiential Learning will be adopted in this course, whenever applicable. In addition to the normal lecturing, students will be demonstrated *in situ* (lab tours at chemical testing/research labs) how separation techniques are being used for various applications as well, e.g. food safety and herbal medicine testing, forensics, environmental analysis, and/or chemical toxicology. For better understanding, students are expected to *read course materials before attending the demonstrations/lectures*.

Reference Books:

1: Principles of Instrumental Analysis, Skoog. Holler. Nieman, Brooks/Cole
2: Quantity Chemical Analysis, Daniel C. Harris, Freeman

Welcomed: Open discussion; ***Not Welcomed:*** Chatting; Cheating

Assessment and Grading

Scheme 1#

- Short Quizzes (20% total; 10% each); **No Makeup quizzes**
- Group Project (25% total; 10% by peers + 15% by instructor & TA)*; &
- Final exam (55%)

Scheme 2#

- Group Project (25% total; 10% by peers + 15% by instructor & TA)*; &
- Final exam (75%)

3 Bonus points for accurately answering questions in class

#Grade awarded based on whichever Scheme is higher score

* In groups of 2, select an ***Interesting, Separating Science-related topic,*** do literature study, give a 15-20 min PowerPoint group presentation to the class. Topic to be approved by Dr. Simon Chan before *18th April, 2026*. Slides send to Dr. Chan and Mr. Wong at least 2 days ahead of presentation.

Sample topics for projects:

- Identification of drugs of abuse and metabolites of drugs of abuse in blood, urine, and saliva
- Monitoring gases in patient's breath during surgery
- Testing for the presence of drugs in blood in race horses and in Olympic athletes
- Dating archaeological specimens
- Analyses of aerosol particles
- Determination of pesticide residues in food
- Monitoring volatile organic species in water supplies

[#] ***Tentative Course Outline:***

Week 1	Introduction to separation science
Week 2	Chromatographic theory
Week 3	Gas Chromatography: Instrumentation
Week 4	• Gas Chromatography: Molecular interactions in GC; • GC in forensic studies
Week 5	Liquid Chromatography: Instrumentation
Week 6	Liquid Chromatography: Different modes of chromatography
Week 7	• LC in food & environ. Analysis • 2-dimensional chromatography: 2D-GC, 2D-LC
Week 8	Mass spectrometry: ionization techniques and mass analyzers
Week 9	Tandem mass spectrometers and their applications in drug discovery, forensic, and food safety testing
Week 10	Hyphenated GC/LC mass spectrometry with case study
Week 11	Sample preparation methods for chromatographic separations & Chemical derivatization for chromatographic separation
Week 12	Quantitative analysis with separation methods with case study: Application of separation science in toxicology study and/or for anti-doping programs
Week 13	**Project presentations**

[#] *Tentative schedule.* Topics/order/pace of lecturing subject to changes depending on progress. Make sure it sounds "worth investing your time", and not too easy/boring for you.

The Hong Kong University of Science and Technology
UG Course Syllabus

Physical Chemistry in Biological Applications
CHEM 4410
3 Credits
Pre-requisites: CHEM 3420

Name: Prof. Jinqing Huang
Email: jqhuang@ust.hk
Office Hours: By email appointments

Meeting Time and Venue
Lectures:
2 Sessions (1.5 hour each) every week
Wed, Fri: (15:00-16:20), Rm 2463

Course Description

This course covers the applications of physical chemistry in biological science and emphasizes the capability in using the fundamental knowledge in physical chemistry to solve the latest research problems in the interdisciplinary areas. Topics include molecular interpretations of the laws of thermodynamics, free energy and physical equilibria in membranes, photochemistry and photobiology, enzyme kinetics, binding and conformation transitions, spectroscopy of biomolecular structures and interactions.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Understand how to interpret fundamental concept from physical chemistry in the application of biological science.

2. Have the skill set to do literature review to gather information for the development of the industry and the academia in biological science.

3. Apply the knowledge from physical chemistry to solve the problems in the application of biological science.

4. Present and criticize the knowledge from physical chemistry in the application of biological science.

Assessment and Grading

Reading Assignments	20%	ILOs 1, 2
Midterm Presentation	40%	ILOs 3, 4
Final Project Report	40%	ILOs 2, 3

Student Learning Resources

Recommended Reading:
"Physical Chemistry: Principles and Applications in Biological Sciences" Tinoco, Sauer, Wang, Puglisi, Harbison, and Rovnyak, Prentice Hall, 5th Edition

Additional Teaching and Learning Activities

After lecture discussions

Course Topics and Schedule

Chapter 1: Molecular Interpretations of the Laws of Thermodynamics
Chapter 2: Free Energy and Physical Equilibria in Membranes
Chapter 3: Photochemistry and Photobiology
Chapter 4: Enzyme Kinetics
Chapter 5: Binding and Conformation Transitions
Chapter 6: Spectroscopy of Biomolecular Structures and Interactions

The Hong Kong University of Science and Technology
UG Course Syllabus

Statistical Machine Learning Methods for Chemical Data Analysis

CHEM 4420

3 Credits

Pre-requisites: CHEM 2409 OR DASC 2010

Exclusion(s): COMP 4211, MATH 4432

Name: Prof. Haibin SU
Email: haibinsu@ust.hk
Office Hours: by appointment
Office: Room 4540, 4/F, Lifts 25/26 Email: haibinsu@ust.hk
Office Tel. Number: 2358-7388

Course Description

The basic knowledge of probability and statistics, chemical data preparation and visualization; numerical methods for chemical data analysis: regression, classification, feature selection and neural network.

Intended Learning Outcomes (ILOs)

By the end of this course, students will be able to:

- 1. Comprehend the fundamentals of statistics and probability.
- 2. Comprehend key ideas, methods, and techniques of machine learning methods.
- 3. Appreciate typical machine learning methods.
- 4. Implement basic chemical data collection, representation and processing.
- 5. Develop machine learning models for a given problem.
- 6. Present ideas and finds effectively, think critically and learn independently.

Class Schedules: **Tues. & Thurs. 4:30pm – 5:50pm, Classroom 2406**
TA: **Mr. Wentao Xu**
Email: wxubq@connect.ust.hk

GenAI Edu platform https://gen-ai-edu.vercel.app

Subject Code	CHEM4420	
Subject Title	Statistical Machine Learning Methods for Chemical Data Analysis	
Credit Value	3	
Level	4	
Description	Design for students would like to learn the basics of machine learning-based data analysis, visualization and to apply these techs to process chemical data.	
Pre-requisite/ Co-requisite/ Exclusion	Pre-Requisite: CHEM 2409 AND CHEM 2410 Exclusion: COMP 4211, MATH 4432	
Objectives	1. Introduce basic concepts of machine learning and data analysis. 2. Enable chemistry students to create their own analytical model. 3. Connect chemistry knowledge with data science.	
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Category A: Professional/academic knowledge and skills</u> 1. Comprehend the fundamentals of statistics and probability. 2. Comprehend key ideas, methods, and techniques of machine learning methods 3. Appreciate typical machine learning methods 4. Implement basic chemical data collection, representation and processing 5. Develop machine learning models for a given problem <u>Category B: Attributes for all-roundedness</u> 6. Present ideas and findings effectively. 7. Think critically. 8. Learn independently. 9. Work in a team and collaborate effectively with others.	
Teaching/Learning Activities	**Class Contact (time-tabled):**	
	Lecture	13 * 3= 39 hours
	Other Student Study Effort	
	preview/review of lecture notes; homework/assignment;	21 hours

	preparation for group project (presentation and report)	45 hours
	Total Student Study Effort	105 hours
Grading Type	Letter Grades	
Assessment Tasks and Grading Policy	**Group project (100% of the course)** • Preliminary proposal (no score): To help students prepare a plan for group project, a preliminary proposal is needed. This proposal should contain: Motivations and objectives, data sets, methodology and expected outcomes. • Group presentation (50% of the course): Each group must give a 20-minute presentation at the end of the semester about the project. • Final report (50% of the course): A final report should be summited. This report should contain all detailed information about the project and contribution of each member in the group.	
Subject Synopsis	Syllabus: • Chap 1: Math Background • Chap 2: Regression and Classification • Chap 3: Supporting Vector Machine • Chap 4: Neural Network • Chap 5: Convolution Neural Network • Chap 6: Chemical/Biological Data Representation • Chap 7: Recurrent Neural Network • Chap 8: Graph Neural Network • Chap 9: Monte Carlo Tree Search Algorithm • Chap 10: Transformer • Chap 11: Decision Tree / Random Forest • Chap 12: Selected applications	
Reading List and References	If you want to learn more about performing data analysis by machine learning, we have a list of suggested books/materials for you: • "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition by Aurélien Géron • "Neural Networks - A Comprehensive Foundation", 3rd Edition by Simon Haykin • "Notes on Statistics and Data Quality for Analytical Chemists", By Michael Thompson and Philip J Lowthian (World Scientific, 2011)	

The Hong Kong University of Science and Technology
UG Course Syllabus

Organometallic Chemistry
CHEM 4620
3 Credits
Pre-requisites: CHEM 3220

Name: Guochen JIA
Email: chjiag@ust.hk
Office Hours: Friday, 2:00 – 3:00 pm

Lectures:
2 Sessions (1.5 hour each) every week
Monday (15:00-16:20), Friday (10:30 – 11:50)

Course Description

This Bonding, structure and reactivity of organometallic compounds, ligand substitution, oxidative addition, reductive elimination reactions, insertions and reactions of coordinated ligands, applications to catalytic processes and organic synthesis.

Course Objectives

- To describe the synthesis and general properties of organometallic compounds.
- To describe fundamental organometallic reactions.
- To describe catalytic reactions involving organometallic compounds with an emphasis on mechanistic understanding.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Recognize organometallic ligands and compounds.

2. Devise synthetic route to common organometallic compounds.

3. Describe fundamental organometallic reactions.

4. Select catalysts for common organometallic based catalytic reactions.

5. Describe mechanisms of common organometallic-based catalytic reactions, and propose catalytic cycles for metal-catalyzed catalytic reactions.

Assessment and Grading

Midterm Exam	45%
Final Exam	55%

Course Outline

1. General properties of organometallic complexes
2. Complexes with metal-carbon σ bond:
   Metal alkyls, aryl, hydride and related σ-bonded ligands
3. Carbonyls, phosphine complexes
4. Complexes of π-ligands
5. Substitution reactions
6. Oxidative addition and reductive elimination
7. Insertion and elimination
8. Nucleophilic and electrophilic addition and abstraction
9. Carbene and carbyne complexes
10. Homogeneous catalysis

The Hong Kong University of Science and Techonology
UG Course Syllabus

Undergraduate Research

CHEM 4680
3 Credits
Prerequisite(s): CHEM 2550

Instructor(s): Research Faculties of Chemistry Department

Course Description

Brief Information/synopsis:

Students do original research in accordance with their ability and background, and under the supervision of a research faculty. The final course grade is determined based on an oral presentation and a written report to be submitted to a judging committee, which includes the faculty supervisor plus at least one other faculty. Enrollment in the course requires approval of the faculty supervisor.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Work independently, to handle and use appropriate instrumentation, interpret data, and complete given tasks in a research setting, and to prepare a written report.
2. Communicate more effectively in speaking and writting, both about students' newly acquired knowledge and knowledge in general.
3. Recognize deficiencies in knowledge existing in chemistry, and plan and mount a research study to address these deficiencies.
4. More critically assess data presented in textbooks, the primary literature or other sources, e.g. electronic databases, patents.
5. Appreciate the importance of research in relation to science, the definition of problems in research, and the corpus of scientific knowledge is able to expand through the overall research effort for the betterment of humankind.

Course Requirements and Grading

At the end of the course, **students are required to give an oral presentation and submit a written report to document their project work**. Course grades will be determined by a faculty panel consisting of their research supervisor and at least one other faculty member. Students will be evaluated based on their research performance, oral presentation (including the Q&A session), and written report.

The Hong Kong University of Science and Technology
UG Course Syllabus

Capstone Project
CHEM 4689
3 Credits
Prerequisite(s): CHEM 3550 and CHEM 3555
Exclusion(s): CHEM 4691

1. **Course Coordinator:**

Prof. Emily M. W. Tsang (chetsang@ust.hk) Rm 4536; Tel: 3469-2100

Faculty Supervisors: (You will be assigned under one supervisor)

Prof. Dennis H.W. CHAN	chanhw@ust.hk
Prof. Jonathan HALPERT	jhalpert@ust.hk
Prof. Yong HUANG	yonghuang@ust.hk
Prof. Emily M. W. TSANG	chetsang@ust.hk
Prof. Kenward VONG	kvong@ust.hk
Prof. Xiaojiang XIE	xiexj@ust.hk
Dr. Ryan T. K. KWOK	chryan@ust.hk
Dr. Sai Ho PUN	punsaiho@ust.hk
Dr. Xiaobin YAO	xiaobinyao@ust.hk
Dr. Chaoshen ZHANG	zhangcs@ust.hk

Library Referencing Advisors: (You will be assigned under one advisor)

Mr. Samson CHOI, Librarian (Learning Support)	lbsamson@ust.hk
Ms. Jennifer GU, Librarian (Learning Support)	lbjennifer@ust.hk

2. **Class Time and Venue:**

Date/Time:	9:30 – 10:20 am, **Fridays** (*please refer to the class schedule*)
Venues:	Room 2126A (Lift 19) OR Library Computer Barn (*please refer to class schedule*)

3. **Course Description:**

Under the supervision of a faculty member or teaching staff, students will complete a capstone project which requires the integration of the chemical knowledge learnt from their previous courses. The project can be delivered through the format of literature review, research, or practical study. A written report and an oral presentation are required to document their learning experiences. For CHEM students under the four-year degree only. Students should seek instructor's approval prior to enrollment in the course.

4. **Intended Learning Outcomes:**

By the end of this course, students should be able to:

1. Demonstrate awareness of chemical topics relevant to social and daily life.

2. Analyze and interpret experimental data, critically assess data in literature and extract useful data from it.

3. Carry out directed research by selecting appropriate topics and procedures, and presenting the results.

4. Communicate effectively both orally and in writing with professionals and/or lay audience.

5. Demonstrate information technology skills, especially in the areas of information retrieval, literature searching and use of library database.

6. Show self-awareness, work independently and collaborate effectively with other people in a team.

5. Assessment and Grading:

Weight	*Assessment*	*Course ILOs*
10%	Participation	1, 2, 3, 4, 5, 6
20%	Submission of a Scientific Poster and Library Training	2, 4, 5
40%	Literature Research Presentation	1, 4, 5, 6
30%	Literature Research Report	1, 2, 3, 4, 5

6. Student Learning Resources (Reference books):

- Catherine E. Housecroft and Alan G. Sharpe, *Inorganic Chemistry* 3rd edition, Harlow: Pearson Prentice Hall ©2008. [QD151.2 .H68 2008] ♠
- Douglas A. Skoog, F. James Holler, Stanley R. Crouch, *Principles of Instrumental Analysis* 6th edition, Thomson Brooks/Cole, ©2007. [QD79.I5 S58 2007]
- Jonathan Clayden, Nick Greeves and Stuart Warren, *Organic Chemistry* 2nd edition: Oxford University Press ©2012 [QD251.3 .O64 2012]
- T.D.H. Bugg, *Introduction to Enzyme and Coenzyme Chemistry* 3rd edition, Wiley ©2012. [QP601.B955 2012eb] ♠

♠ *Free access online via HKUST Library*

^ *other course materials can be downloaded from Canvas website by logging in using your ITSC username and password (http://canvas.ust.hk).*

7. Teaching and Learning Activities:

Tutorials/Workshops:
1. Literature Search Training
2. SciFinder Workshop
3. Chemical Structure Drawing Training
4. Literature Referencing Training
5. Poster Design Workshop

Consultations: With your faculty supervisor (**at least 3 times**)

Individual Coaching: With your library referencing advisor (**at least once**)

Oral presentation: 10 minutes + 5 minutes Q&A

Poster Mini-Conference: 3 hours session at the end of semester

8. Course Schedule:

Week	Date/Time	Activities [† *denotes follow-up work required*]	Venue/Instructor
1	Feb 6 (Fri) 9:30-10:20 *before Feb 20*	**Course Introduction** [† ***meet your supervisor for topic assignment***] [† ***upload research topic to Canvas***]	**Room 2126A (Lift 19)** Prof. Emily Tsang
2	Feb 13 (Fri) 9:30-10:20	**Literature Search Training**	**Library LG1 Computer Room B** Mr. Samson Choi
3	Feb 20 (Fri) 9:30-10:20 *before Feb 20* *between Feb 23 – Mar 13*	**SciFinder Workshop** [† ***submit Weekly Timetable to Canvas for scheduling Oral Presentation Time***] **Individual Coaching Session on Literature Search** [***Compulsory***] (with your Referencing Advisor during Weeks 4 – 6)	**Zoom Meeting** SciFinder vendor (based in Singapore) (by appointment with your referencing advisor)
4	Feb 27 (Fri) 9:30-10:20	**Chemical Structure Drawing Training**	**Library LG1 Computer Room B** Prof. Emily Tsang
5	During this week (Mar 2 – 6)	**1st Consultation with supervisor**	(by appointment with your supervisor)
6	Mar 9 – 13 *before Mar 16*	*Work on your project* [† ***submit Research Plan***]	
7	Mar 20 (Fri) 9:30-10:20	**Referencing Training**	**Library LG1 Computer Room B** Mr. Samson Choi
8 - 9	During this week (Mar 23 – Apr 2)	**2nd Consultation with supervisor**	(by appointment with your supervisor)
9	Apr 10 9:30-10:20	**Poster Design Workshop**	**Room 2126A (Lift 19)** Dr. Frederick Sheong
10	Apr 13 – 17 *between Apr 13 – 30*	*Work on your project* **Individual Coaching Session on Referencing** [***Optional***] (with your Referencing Advisor during Weeks 10 – 12)	(by appointment with your referencing advisor)
11	During this week (Apr 20 – 24)	**3rd Consultation with supervisor**	(by appointment with your supervisor)
12	Apr 27 – May1	*Work on your project*	
13	May 8 (Fri) *before May 3 (Sun)*	**Oral Presentations** [† ***submit Poster file to Canvas***]	TBA
Study break	May 11 (Mon) 14:00-16:30	**Poster Mini-Conference**	**Library LG4** **Multi-function Room**
	May 17 (Sun)	† ***Deadline for Literature Research Report***	

The Hong Kong University of Science and Technology
UG Couse Syllabus

Capstone Research I
CHEM 4691
3 Credits
Prerequisite(s): CHEM 3550 and CHEM 3555
Exclusion(s): CHEM 4689

Instructor(s)/Project Supervisor(s): Research Faculties of Chemistry Department
Course Coordinator: Prof. Emily M. W. Tsang
Reference Librarians: Mr. Samson CHOI (lbsamson@ust.hk)
Ms. Jennifer GU (lbjennifer@ust.hk)

Course Description

Students will carry out a research project in one of the Chemistry research laboratories under the supervision of a faculty member. This research-based course provides students an opportunity to integrate and apply their chemical knowledge learnt in regular lecture and laboratory courses. At the end of the course, students are required to submit a written report and deliver an oral presentation to document their learning experiences. For CHEM students only. Students should seek instructor's approval prior to enrollment in the course.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Demonstrate awareness of chemical topics relevant to social and daily life.
2. Analyze and interpret experimental data, critically assess data in literature and extract useful data from it.
3. Carry out directed research by selecting appropriate topics and procedures, and presenting the results.
4. Communicate effectively both orally and in writing with professionals and/or lay audience.
5. Demonstrate information technology skills, especially in the areas of information retrieval, literature searching and use of library database.
6. Show self-awareness, work independently and collaborate effectively with other people in a team.

Grading and Assessment

Weight	Assessment	Course ILOs
50%	Lab Performance and Participation	1,2,3,4,5,6
30%	Written Research Thesis	1,2,3,4,5
20%	Oral Presentation	4,5,6

Mandatory Library Trainings Schedule:

The following library training workshops are ***mandatory.*** Attendances will be taken and counted towards your course participation scores.

Date	Activity	Venue
Feb 13 (Fri), 9:30 – 10:20	**Library Workshop I: Literature Search Training**	Computer Room B (Library LG1) (Mr. Samson Choi)
Feb 20 (Fri), 9:30 – 10:20	**SciFinder-n Workshop**	Zoom Meeting (meeting link to be provided)
Feb 27 (Fri), 9:30 – 10:20	**Chemical Structure Drawing Training**	Computer Room B (Library LG1) (Prof. Emily Tsang)
Mar 20 (Fri), 9:30 – 10:20	**Library Workshop II – Reference Training**	Computer Room B (Library LG1) (Mr. Samson Choi)

The Hong Kong University of Science and Technology

UG Couse Syllabus

Capstone Research II

CHEM 4692

3 Credits

Prerequisite(s): CHEM 4691

Name: Research Faculty of Chemistry

Course Description

Continuation of research project started in CHEM 4691 and to be conducted under the supervision of a faculty member/teaching staff. A written report and oral presentation are required to document their learning experiences. Students should seek instructor's approval prior to enrolment in the course.

Brief Information/synopsis:

This is a project-based course that provides students an opportunity to integrate and apply their chemical knowledge learnt in regular lectures and lab courses. Students will carry out a research project under the supervision of a faculty member/teaching staff. At the end of the course, students are required to submit a written report and deliver an oral presentation to document their learning experiences. Students should seek instructor's approval prior to enrolment in the course.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Demonstrate awareness of chemical topics relevant to social and daily life.
2. Analyze and interpret experimental data, critically assess data in literature and extract useful data from it.
3. Carry out directed research by selecting appropriate topics and procedures, and presenting the results.
4. Communicate effectively both orally and in writing with professionals and/or lay audience.
5. Demonstrate information technology skills, especially in the areas of information retrieval, literature searching and use of library database.

6. Show self-awareness, work independently and collaborate effectively with other people in a team.

Grading

Weight	Assessment	Course ILOs
50%	Lab Performance and Participation	1,2,3,4,5,6
30%	Written Research Thesis	1,2,3,4,5
20%	Oral Presentation	4,5,6